COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR
23032 SERIES

INCLUDES MODELS
23032-010, 23032-011, 23032-018, 23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-045, 23032-046, 23032-047, 23032-048, 23032-049, 23032-051, 23032-052, 23032-054, 23032-062

ORIGINAL ISSUE: JULY 15, 1966
REVISION 15: JUNE 27, 2023

EXCLUSIVE DISTRIBUTORS

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A. Customer Portal

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HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator Models 23032-010, -011, -018, -025, -026, -027, -028, -042, -043, -044, -045, -046, -047, -048, -049, -051, -052, -054 and -062.

Attached to this transmittal letter is Revision No. 15 of the Component Maintenance Manual with IPL (original issue dated July 15, 1966).

REVISION 15, JUNE 27, 2023

Remove the complete existing manual and replace with this full revision of the manual. Retain the Highlights page(s) in the front of the manual for future reference.

This Component Maintenance Manual has been fully revised to include the latest engineering information and also to include Temporary Revisions, Service Bulletin(s) and Service Information Letter(s) as listed in the Record of Temporary Revisions, Service Bulletin List and Service Information List in the front of the manual.

The contents of this revision only has technical changes individually identified with revision bars because the new format of the Safran Power manuals was significantly changed to be more consistent with current standards set by the Air Transport Association of America Specification ATA-100.

Key items included in this revision:

- Copyright information date changed to 2023.
- Changes done in Introduction section:
  - Updated the overhaul practices.
  - Added process verification section.
- Changes done in Illustrated Parts List section:
  - Incorporated the TR 24-14 to add screw P/N MS35265-45 as a replacement for the P/N AN500A8-8 for effect codes “IJKLMNP”.

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RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	July 15/66	July 15/66	SP
Revision 1	Dec 2/68	Dec 2/68	SP
Revision 2	Dec 15/70	Dec 15/70	SP
Revision 3	Apr 15/73	Apr 15/73	SP
Revision 4	Feb 15/77	Feb 15/77	SP
Revision 5	Dec 14/78	Dec 14/78	SP
Revision 6	Dec 7/81	Dec 7/81	SP
Revision 7	Mar 1/83	Mar 1/83	SP
Revision 8	Mar 25/83	Mar 25/83	SP
Revision 9	July 20/84	July 20/84	SP
Revision 10	Dec 22/00	Dec 22/00	SP
Revision 11	Dec 18/01	Dec 18/01	SP
Revision 12	Jun 22/10	Jun 22/10	SP
Revision 13	Mar 08/17	Mar 08/17	SP
Revision 14	Mar 25/22	Mar 25/22	SP
Revision 15	Jun 27/23	Jun 27/23	SP

Revision Number	Date Issued	Date Inserted into CMM	Initials

Retain this record in the front of the CMM. On receipt of revisions, insert affected pages into the manual. Record revision number, date issued, date inserted into the CMM, and initials on this page.

RECORD OF TEMPORARY REVISIONS

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials
24-01	1011	Feb 28/02	Feb 28/02	SP	Jun 22/10	SP
24-02	5012	Apr 24/03	Apr 24/03	SP	Jun 22/10	SP
24-03	Various	Mar 27/06	Mar 27/06	SP	Jun 22/10	SP
24-04	7019	Oct 17/14	Oct 17/14	SP	Mar 08/17	SP
24-05	10023	Apr 05/16	Apr 05/16	SP	Mar 08/17	SP
24-06	10022	Apr 26/16	Apr 05/16	SP	Mar 08/17	SP
24-07	6	Aug 21/18	Aug 21/18	SP	Mar 25/22	SP
24-08	10015	Aug 21/18	Aug 21/18	SP	Mar 25/22	SP
24-09	1013	Aug 21/18	Aug 21/18	SP	Mar 25/22	SP
24-10	10014	Aug 21/18	Aug 21/18	SP	Mar 25/22	SP
24-11	3003	Aug 21/18	Aug 21/18	SP	Mar 25/22	SP
24-12	7021	Aug 21/18	Aug 21/18	SP	Mar 25/22	SP
24-13	6003	Sep 09/19	Sep 09/19	SP	Mar 25/22	SP
24-14	10020	Apr 10/23	Apr 10/23	SP	Jun 27/23	SP

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials

Retain this record in the front of the CMM. On receipt of temporary revisions, insert affected pages into the manual. Record the temporary revision number, page number, date issued, date inserted into the CMM, and initials on this page. When temporary revisions are removed from the CMM, record the date removed and initials.

SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
SB-153	Incorporated	-	Dec 20/68				
SB-155	Incorporated	-	April 01/69				
SB-169-1	Incorporated	1	Jun 01/73				
SB-194A	Incorporated	-	Oct 15/73				
23032-04	Incorporated	1	Dec 01/78				
23032-05	Incorporated	2	Nov 20/78				
23032-06	Incorporated	1	Dec 04/78				
23032-07	Incorporated	-	Jun 07/82				
23032-0XX-24-01	Incorporated	-	Oct 15/90				
23032-0XX-24-02	Superseded	1	Apr 22/94				
23032-04X-24-01	Incorporated	-	Jan 21/92				
23032-0XX-24-03	Incorporated	1	Jul 29/94				
23032-0XX-24-04	Incorporated	-	Jun 16/00				
23032-0XX-24-05	Incorporated	1	Aug 20/18				

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued

Retain this record in the front of the CMM. On receipt of service bulletins, record the service bulletin number, status (valid or invalid), revision number (if applicable) and the date issued.

SERVICE INFORMATION LETTER LIST

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued
GSIL 2006-01	Incorporated	-	Sep 26/06				
GSIL 2006-02	Incorporated	1	Feb 10/09				
GSIL 2007-01	Incorporated	-	Jul 30/07				
02-5600	Incorporated	4	Jul 07/15				
03-6009-XX-01	Incorporated	-	May 02/95				
23033-1141-01	Incorporated	-	May 01/90				
23701	Incorporated	1	Jun 19/00				
23703	Incorporated	-	Jan 24/97				
23032-1910-24-01	Incorporated	1	Feb 14/22				
GIL K4358-24-003	Valid	1	Jan 10/17				
GSIL 2020-01	Valid	1	Apr 16/21				

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued

Retain this record in the front of the CMM. On receipt of Service Information Letters, record the Service Information Letter number, status, revision number (if applicable) and the date issued.

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for overhaul and service repair of the 23032 Series DC Starter-Generators. Line Maintenance is supported by Maintenance (MM) Manual 23700.

A. Overhaul Requirements

DC Starter-Generator overhaul occurs during regular scheduled maintenance to examine and, where necessary, repair or replace damaged or worn parts and assemblies. After overhaul and after the Starter-Generator has passed all acceptance tests, the Starter-Generator is assigned zero operating hours Time Since Overhaul (TSO). Selective equipment repairs, without overhaul, do not affect the TSO. A DC starter-generator overhaul includes:

(1) Replacement of non-reusable parts such as bearings, brushes, O-rings, and locking hardware. Replace all damaged, deformed, corroded or apparently defective hardware.

(2) Cleaning of subassemblies.

(3) Detailed inspection of parts, electrical check of all electromagnetic parts (including insulation integrity check), Non-Destructive Test (NDT) inspections, and complete inspection testing.

NOTE: Magnetic particle inspection of the parts as specified in the CHECK section is only required when an overhaul of the generator assembly is being done.

(4) Check of brush holder alignment.

(5) Commutator refinishing and check balance.

(6) Reconditioning of surface finishes as required.

(7) Repair/rework of parts as required.

(8) Recertification, including final assembly, records, and release tags.

B. Repair Requirements

An illustrated parts list is included at the back of this CMM for part identification and ordering of approved replacement parts. The structure and content of this manual is in general accordance with the requirements established by the Air Transport Association of America (ATA) for aircraft CMMs. This manual is formatted to conform to ATA Specification No. 100.

All weights and measures used in this manual are in English units, followed by the Système Internationale (SI) equivalent in parentheses.

Give careful attention to applicable warnings and cautions. Before you start any overhaul procedure, become thoroughly familiar with the capabilities and limitations of the equipment. Make sure all necessary safety equipment, test equipment, repair materials, special tools, and fixtures are available before you start.

If an error, omission, or other technical discrepancy is found in this manual, fill out a copy of the Technical Publication Comment Form found at the back of this manual and send to Supervisor of Technical Publications, Safran Power or provide information to Technical Publications e-mail at lps.twn.techservice@safrangroup.com.

Publications can be obtained by contacting the Web Portal. https://techpubsdistribution.safran-electrical-power.com.

2. User Qualification and Certification Requirements

The information contained in this manual is to be used by persons trained and certified in the repair and overhaul of aircraft electrical accessories. Eligibility and certification of overhaul technicians shall be in accordance with the guidelines established by the U.S. Federal Aviation Administration or an equivalent regulatory authority. (Refer to U.S. Code of Federal Regulations 14 CFR, parts 65.101 through 65.103 and part 145.33.)

Where special processes are included by reference to military or commercial standards, the qualifications and certification of personnel performing the process shall be as indicated in the standard. Strictly follow the detailed requirements of all military or commercial standards used in the repair of this equipment.

3. Quality Assurance Requirements

The repair station's quality assurance activity is responsible for the correct performance of all tests and inspections specified in this manual. The quality assurance activity shall also be responsible for maintaining all necessary test, inspection, and maintenance records for each unit received for service.

All instrumentation and inspection equipment used shall be calibrated and controlled per ISO 10012-1 with all standards traceable to the National Bureau of Standards or an equivalent standards regulatory authority.

Quality Assurance shall be responsible for certifying that personnel, skills, and materials meet the requirements of the work to be performed. Quality assurance shall also maintain documented evidence that specifications (applicable to special processes such as soldering, non-destructive testing, plating, etc.) have been complied with during repair and/or overhaul of the starter-generator.

Components of the starter-generator undergoing overhaul that are recovered as products of disassembly shall be examined 100% to determine serviceability.

4. Safety Advisory

This manual describes physical and chemical processes which use chemicals or other commercially available materials where precautionary attention is necessary.

The user of this manual should get material safety data sheets, Occupational Safety and Health Act (OSHA) Form 20 or equivalent, from the manufacturers or suppliers of materials to be used. The user must become completely familiar with, and follow, all manufacturer/supplier procedures, recommendations, warnings and cautions for the safe use, handling, storage, and disposal of these materials. Users of this manual are also advised to refer to applicable safety information contained in the “NIOSH Occupational Guideline for Chemical Hazards” published by the United States Department of Labor.

WARNING: **ALERTS OPERATING AND MAINTENANCE PERSONNEL TO POTENTIAL HAZARDS THAT COULD RESULT IN PERSONAL INJURY; WARNINGS DO NOT REPLACE THE MANUFACTURER’S RECOMMENDATIONS.**

CAUTION: ALERTS OPERATING AND MAINTENANCE PERSONNEL TO CONDITIONS THAT COULD RESULT IN EQUIPMENT DAMAGE.

5. Process Verification

VALIDATION OF OPERATIONS DESCRIBED IN THIS MANUAL

The maintenance operations described in this manual have been checked in manufacturer’s workshop by an extract carrying out of dismantling, reassembly, test and repair instructions which are detailed in this document.

These operations are those in use at the latest revision date of the document.

CAUTION: THIS MANUAL PROVIDES THE NECESSARY INFORMATION TO PERFORM THE REPAIR IN AN DEPOT LEVEL MAINTENANCE SHOP (D-LEVEL).
THE MANUAL IS AT THE 3RD LEVEL OF MAINTENANCE (D-LEVEL).

6. Materials List

The materials listed in this section are necessary for processes throughout this manual. A warning and/or caution will precede the use of materials listed in Table i.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH MANUFACTURER OR SUPPLIER RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Material	Used in…
Acrylic Coating	REPAIR, ASSEMBLY
Black Gloss Enamel	REPAIR, ASSEMBLY
Cleaning Solvent	CLEANING, REPAIR, ASSEMBLY
Conversion Coating	REPAIR, ASSEMBLY
Detergent	CLEANING
Grease	STORAGE
Isopropyl Alcohol	CLEANING, REPAIR, ASSEMBLY
Lubricating and Assembly Paste	ASSEMBLY
Lubricating Oil	REPAIR
Red Insulating Enamel	REPAIR, ASSEMBLY
Sealing Compound	REPAIR
Thread Sealing Compound	ASSEMBLY
Zinc Chromate Primer	REPAIR, ASSEMBLY

Table i - Hazardous Materials

7. Authorized Components and Processes Policy

Safran Power authorizes the use of genuine Safran Power spare parts which meet stringent engineering design specifications and quality standards, and have traceability to having been procured and certified to these specifications by the Safran Power Quality Assurance incoming and in-process inspection systems. The Safran Power spares portal is the only authorized distributor of genuine Safran Power replacement parts and complete units.

The use of any non-Safran Power parts, or any parts not having been submitted to the Safran Power Quality Assurance inspection system will invalidate any and all factory warranties. All Safran Power warranties are automatically voided on any Safran Power designed unit that has been modified by the installation of any unauthorized parts, materials or unapproved processes supplied by other outside services. The repair station's quality assurance activity shall assume product liability for all units that have been modified in this fashion.

Damage resulting from the use of non-Safran Power replacement parts, materials or processes is not covered by the warranty or service policy for any product or for any application.

All repair and service facilities are obligated to provide the FAA, or any other in-county air authority, with proper traceability documentation indicating approval of all spare parts, materials and processes to ensure configuration compliance and continued air worthiness.

8. Abbreviations

The following abbreviations have been used in this manual. Standard abbreviations are not listed.

ADE	- anti-drive end
CMM	- Component Maintenance Manual
DE	- drive end
GCU	- Generator Control Unit
IAW	- in accordance with
lbf.in.	- pounds force inches
IVD	- Ion vapor deposition
kPa	- kilopascals
N·m	- Newton-meter(s)
NDT	- Non-Destructive Test
psi	- pounds per square inch
QAD	- Quick attach/detach
rms	- rms = 0.707 peak-to-peak for sine wave of AC waveform.
RPM	- Revolutions Per Minute
SI	- System Internationale (SI); i.e., English Measurement followed by Metric equivalents.
SPD	- Standard Practice Document
TIR	- Total Indicator Reading
TSO	- time since overhaul
Ω	- Ohm

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DESCRIPTION AND OPERATION

1. Equipment Description

The 23032 Series DC Starter-Generators are designed to provide torque for engine starting and to generate 30 volts DC electrical power. Refer to the ILLUSTRATED PARTS LIST section for an illustration and parts breakdown of the Starter-Generator.

The 23032 DC Starter-Generator (See Figure 1) is an air-cooled, self-excited, brush-type unit that consists of a stator and housing assembly incorporating four main poles and four interpoles, an armature assembly attached to a dampening type drive shaft, end bell bearing supports, brush assembly, fan assembly, and terminal block assembly.

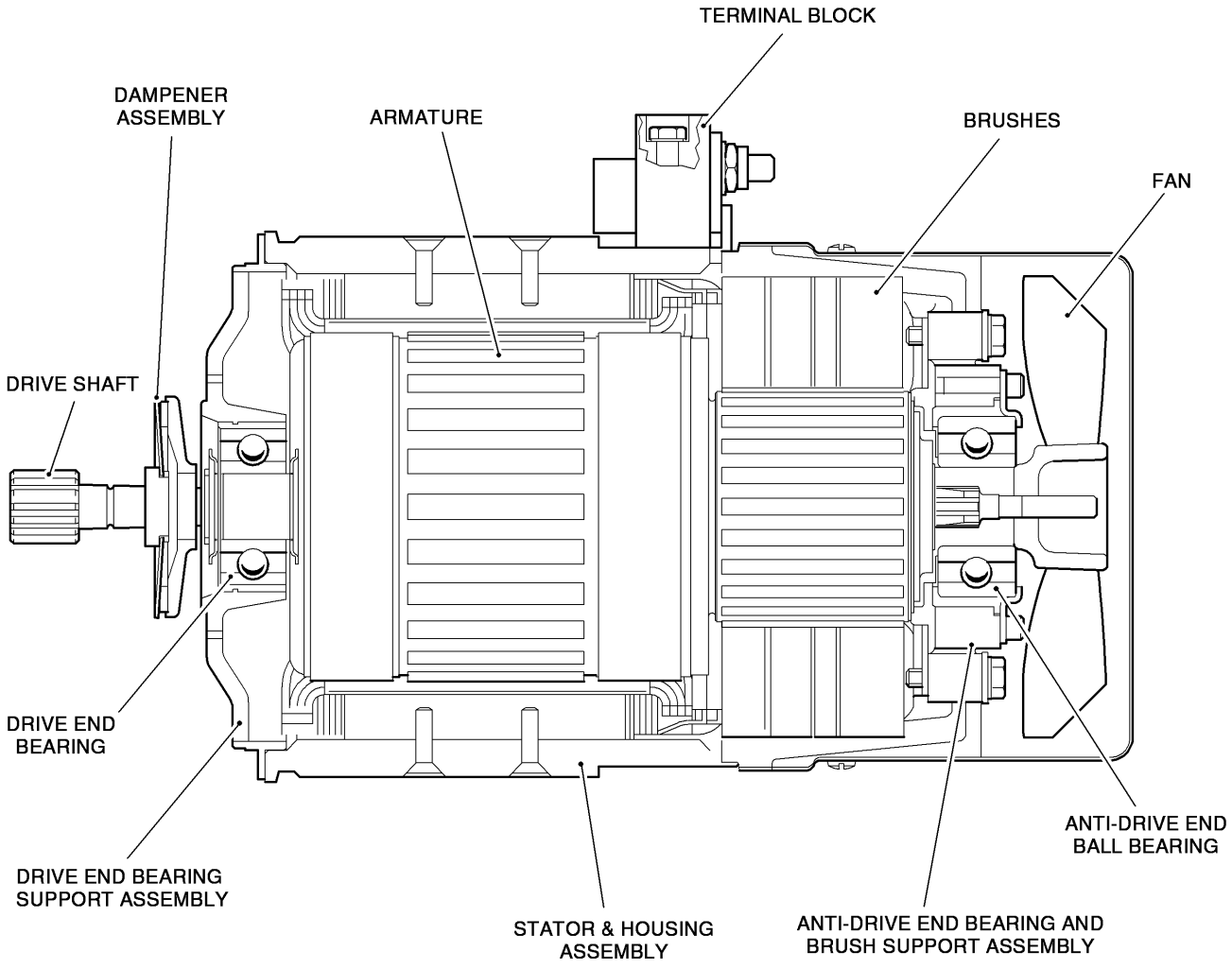

Figure 1 - Model 23032 Series DC Starter-Generator Features

The drive shaft is splined on both ends; at the drive end for engaging the engine gearbox, and at the anti-drive end for internal coupling to the armature shaft. The anti-drive end also contains a mounting surface and threaded end for attaching the fan assembly. The drive shaft is provided in either dry or wet spline styles depending on the starter-generator model; the wet spline style uses a preformed packing (O-ring) on the drive end spline. The drive shaft and attached armature assembly are supported by bearings mounted in the drive and anti-drive end bells. At the drive end of the drive shaft is a clutch-type dampener assembly that absorbs torsional vibration generated by changes in engine gearbox speed and electrical load conditions.

Electrical connection to the Starter-Generator is made at the terminal block assembly. Internally, electrical power passes through the armature and stators via a radio noise filter in the terminal block assembly and the commutator brush assemblies attached to the anti-drive end bell. Some, but not all, models contain two filter boards that provide ripple voltage filtering for the DC output voltage. These filter boards are attached to the brush assemblies on the anti-drive end bell.

Unit cooling at all rated conditions is achieved by the fan assembly drawing in air through the anti-drive end. The fan is protected by a screen cover.

The Starter-Generator is mounted on the engine mounting pad by using an appropriate Quick Attach-Detach (QAD) kit, as specified in the ILLUSTRATED PARTS LIST. The QAD kit, which consists of a drive-end pad end-bell and a rim-clenching clamp, is only supplied with certain models of the Starter-Generator. For all other models, the QAD kit must be ordered separately.

2. Operation

CAUTION: THE STARTER FUNCTION SHOULD NOT BE ACTIVATED FOR MORE THAN THE FEW SECONDS NEEDED FOR A NORMAL ENGINE START. LARGE START CURRENTS AND LONG START TIMES CREATE EXCESSIVE TEMPERATURES THAT CAN DAMAGE THE STARTER-GENERATOR.

When used as an engine starter, the Starter-Generator can be energized either by batteries or by ground-power units. The Starter-Generator uses a series starting field that should only be activated when the shunt field is de-energized.

When operating as a generator, the Starter-Generator provides rated DC output at rotational speeds within the rated speed range.

The generator will operate satisfactorily with either a carbon-pile or static type regulator. A reverse-current relay is normally used for automatically disconnecting the generator from the load bus, if generator voltage drops below a pre-determined minimum.

Electrical and mechanical characteristics of 23032 Series DC Starter-Generators are provided in Table 1, Table 2 and Table 3. Refer to Figure 2 through Figure 9 for physical characteristics.

Characteristics	Specification
Rated Power Output	4.50 kW 23032-010, 23032-011, 23032-018, 23032-025,23032-026, 23032-027, 23032-028,23032-042, 23032-043, 23032-044,23032-048, 23032-049 4.80 kW 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062
Rated Voltage	30 VDC nominal; 26-30 VDC over speed range
Speed Range:	See Table 2.
Continuous Load in Speed Range	See Table 2 (Cont. Load)
Air Opening (Diameter)	4.5 inch (114,3 mm)
Direction of Rotation	Counterclockwise (viewing drive-end)
Weight (Less QAD kit)	See Table 2. (Weight)
Overhung Moment	See Table 3. (Overhung Moment)
Mounting Pad/Flange	AND 10261, Type XI-B, AND 20001, or MS3331-1. See IPL for appropriate QAD mounting kit.
Drive Spline	12 Teeth; 0.60 inch (15,2 mm) pitch diameter
Terminal Designations: B + E – A + D C +	Positive Negative Positive field Equalizer Starting
External Start Power	28 VDC, 500 A max.
Overall Length (Less spline drive)	See Table 2.
Housing Diameter (over clamp)	See Table 2.

Table 1 - Equipment Specifications

Model 23032-(*QAD Kit incl with model)	Speed Range (RPM)	Housing Diameter in.(mm)	Cont. Load	Overall Length in.(mm)	Weight (*Incl QAD Kit) lbs (kg)
010	8100-12000	5.25 (133,4)	150 A	7.96 (202,2)	17.0 (7,71)
011	8100-12000	5.25 (133,4)	150 A	7.96 (202,2)	17.0 (7,71)
018	8100-12000	5.25 (133,4)	150 A	8.04 (204,2)	17.0 (7,71)
025	8100-12100	5.27 (133,9)	150 A	7.62 (193,6)	16.2 (7,35)
*026	8100-12100	5.27 (133,9)	150 A	7.62 (193,6)	*17.05 (7,73)
027	8100-12100	5.27 (133,9)	150 A	7.62 (193,6)	16.2 (7,35)
*028	8100-12100	5.27 (133,9)	150 A	7.62 (193,6)	*17.05 (7.73)
042	8100-12100	5.25 (133,4)	150 A	6.43 (163,3)	16.3 (7,39)
043	8100-12100	5.25 (133,4)	150 A	7.62 (193,6)	16.15 (7,32)
*044	8100-12100	5.25 (133,4)	150 A	7.62 (193,6)	*17.0 (7,71)
*045	8400-12100	5.25 (133,4)	160 A	7.96 (202,2)	*17.6 (7,98)
046	8400-12100	5.25 (133,4)	160 A	7.96 (202,2)	17.4 (7,89)
*047	8400-12100	5.25 (133,4)	160A	7.96 (202,2)	*17.6 (7,98)
048	8100-12100	5.27 (133,9)	150 A	7.62 (193,6)	16.5 (7,48)
*049	8100-12100	5.27 (133,9)	150 A	7.62 (193,6)	*17.35 (7,87)
051	8400-12100	5.25 (133,4)	160 A	7.96 (202,2)	17.0 (7,71)
052	8400-12100	5.25 (133,4)	160 A	9.67 (245,6)	*17.6 (7,98)
054	8400-12100	5.25 (133,4)	160 A	9.67 (245,6)	17.4 (7,89)
062	7700-12100	5.27 (133,9)	160 A	9.65 (245,1)	17.0 (7,71)

Table 2 - Equipment Specification Details

Model 23032-	Overhung Moment lbf.in (N·m)	Shaft Shear Section Torque lbf.in (N·m) Max.
010	55.0 (6,21)	550 (62,1)
011	55.0 (6,21)	550 (62,1)
018	55.0 (6,21)	550 (62,1)
025	55.0 (6,21)	650 (73,4)
026	55.0 (6,21)	650 (73,4)
027	55.0 (6,21)	550 (62,1)
028	55.0 (6,21)	550 (62,1)
042	55.0 (6,21)	550 (62,1)
043	55.0 (6,21)	365 (41,2)
044	55.0 (6,21)	365 (41,2)
045	57.0 (6,44)	550 (62,1)
046	57.0 (6,44)	550 (62,1)
047	57.0 (6,44)	550 (62,1)
048	55.0 (6,21)	550 (62,1)
049	55.0 (6,21)	550 (62,1)
051	57.0 (6,44)	550 (62,1)
052	57.0 (6,44)	550 (62,1)
054	57.0 (6,44)	550 (62,1)
062	71.8 (8,11)	664 (75,0)

Table 3 - Overhung Moment and Shaft Shear Torque

3. MOD Status

See Table 4 below for the latest MOD level of each Starter-Generator model:

Models	MOD	Description
23032-010, -011, -025, -026, -027, -028, -042, -043, -044	A	P/N: 03-6009-19 Bearings
	B	P/N: 03-6009-23 Bearings
23032-018	-	No MODs
23032-045, -046, -047, -048, -049, -051, -052, -054	A	P/N: 03-6009-18 Bearings
23032-062	A	P/N: 23081-306 End Bell Assembly
23032-045, -046, -047, -051, -054	B	P/N: 23081-1855 Brushes

Table 4 - MOD Status

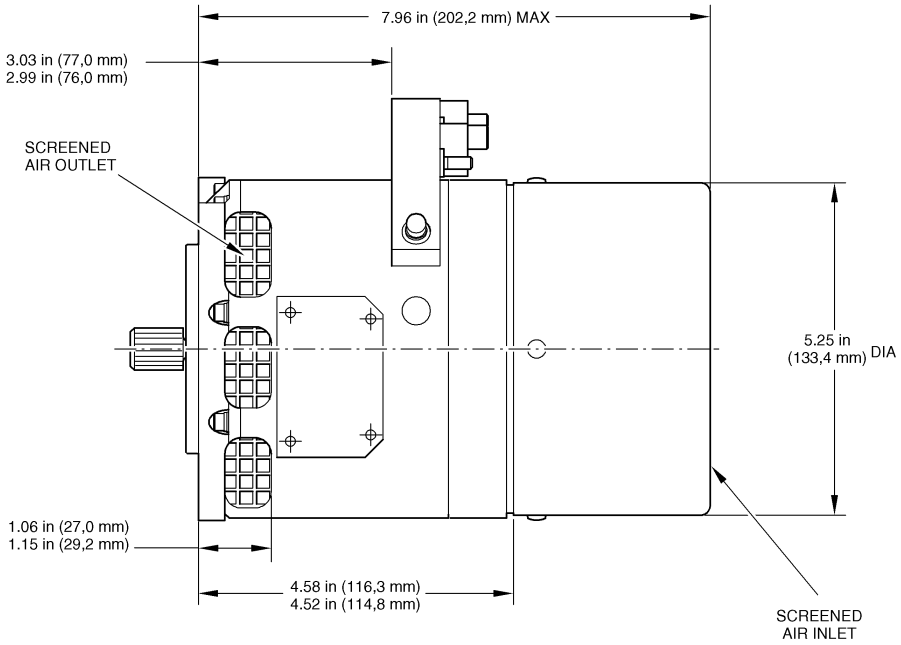

Figure 2 - Outline Drawing 23032-010, -011 and -018

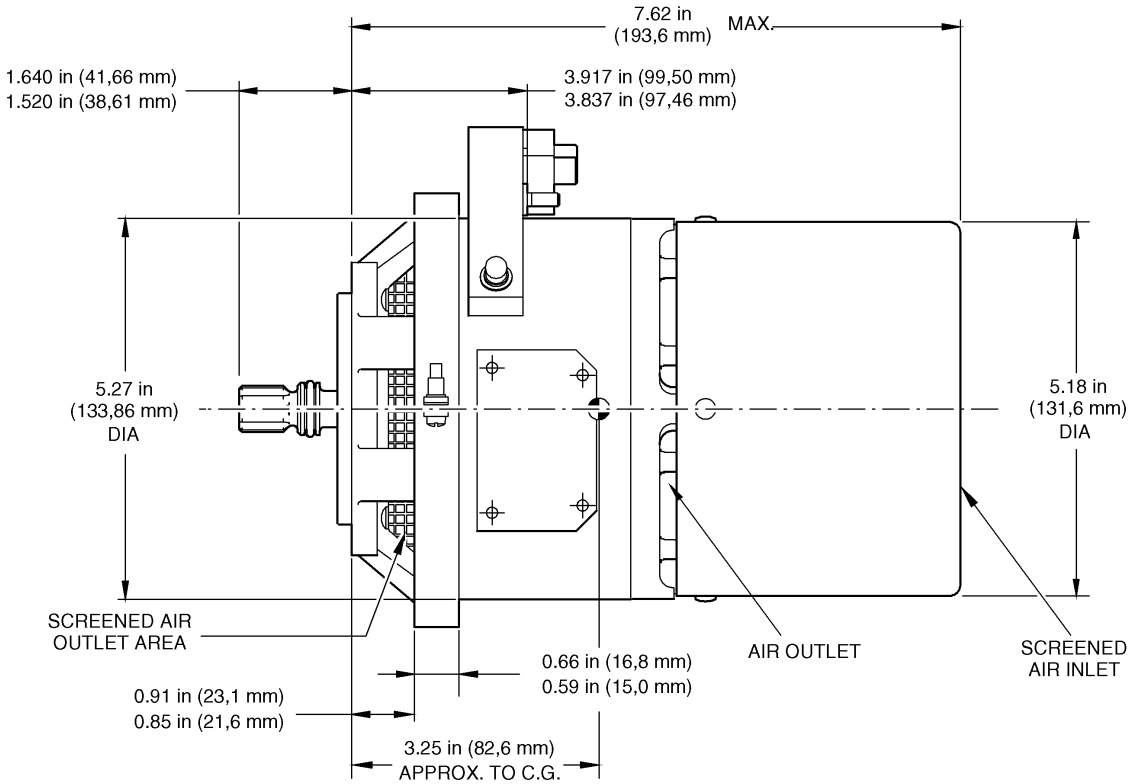

Figure 3 - Outline Drawing 23032-026, -028 and -044

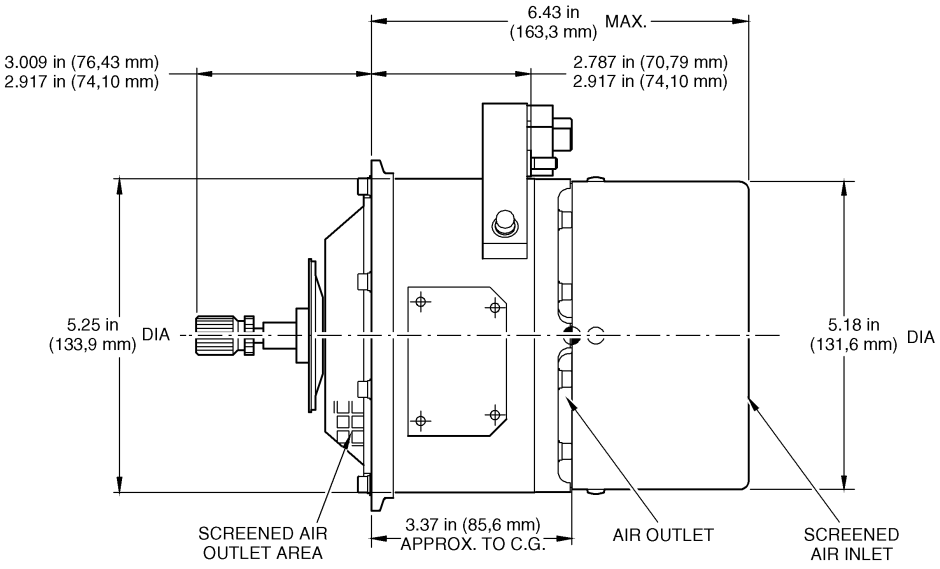

Figure 4 - Outline Drawing 23032-042

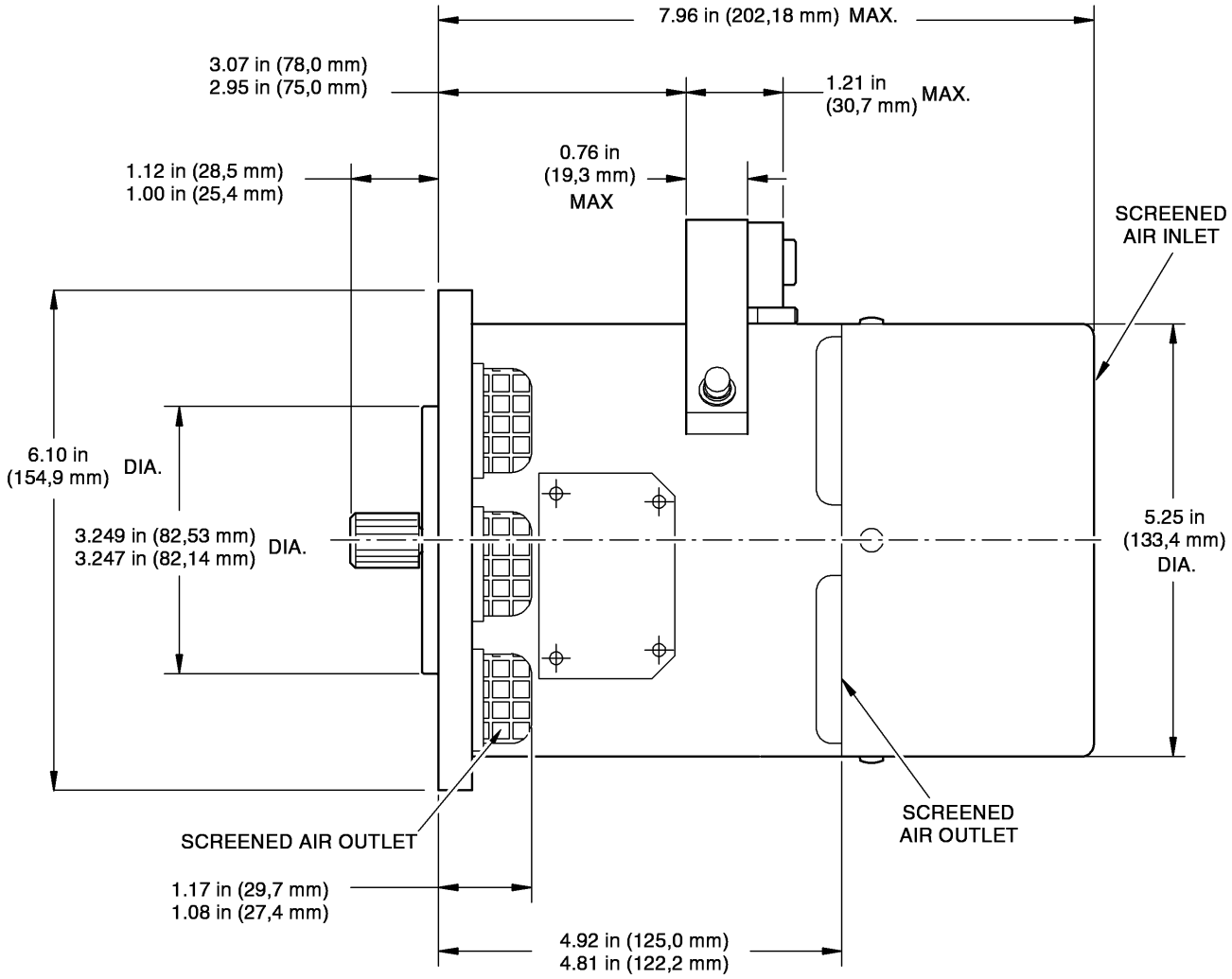

Figure 5 - Outline Drawing 23032-045

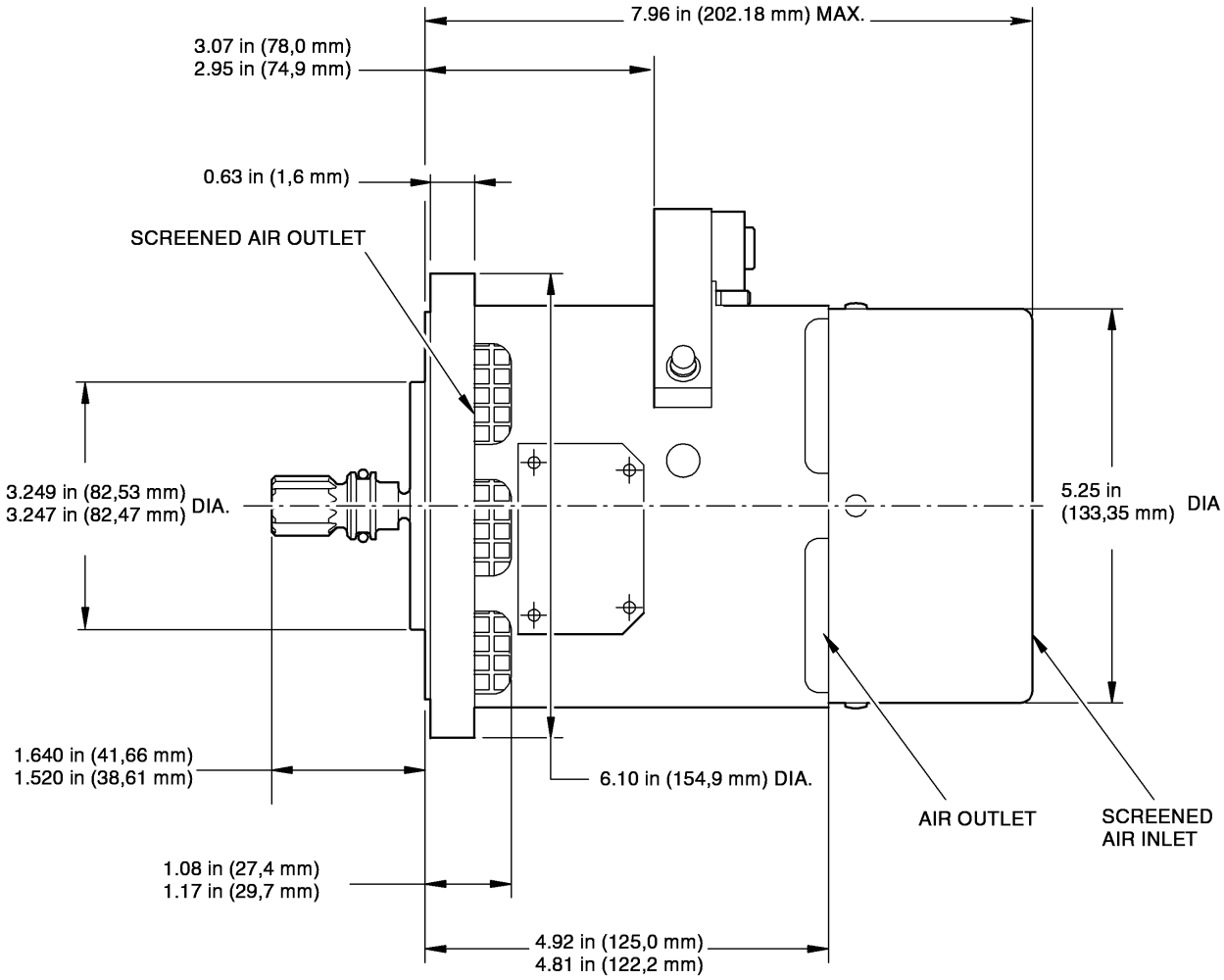

Figure 6 - Outline Drawing 23032-047, -051

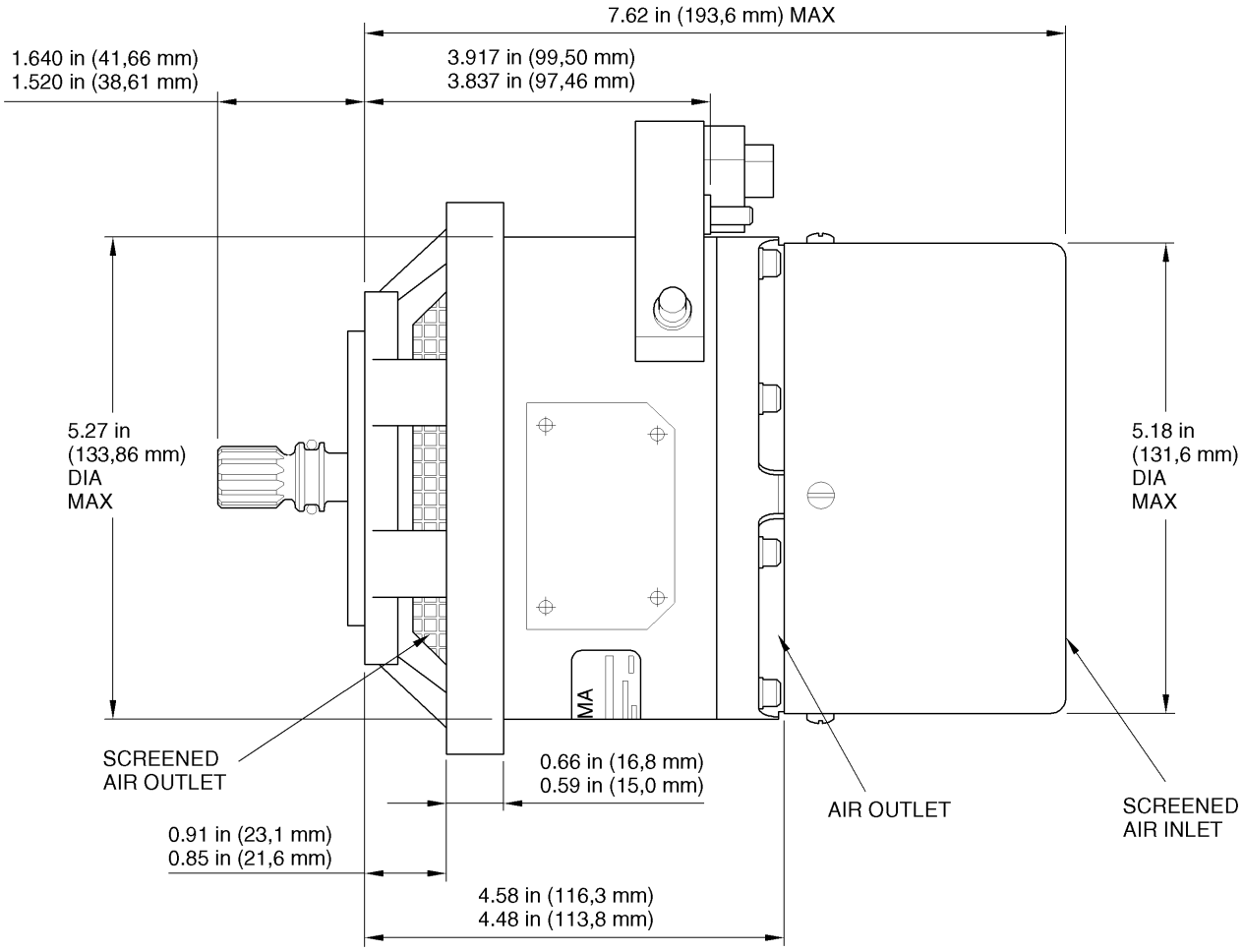

Figure 7 - Outline Drawing 23032-048, -049

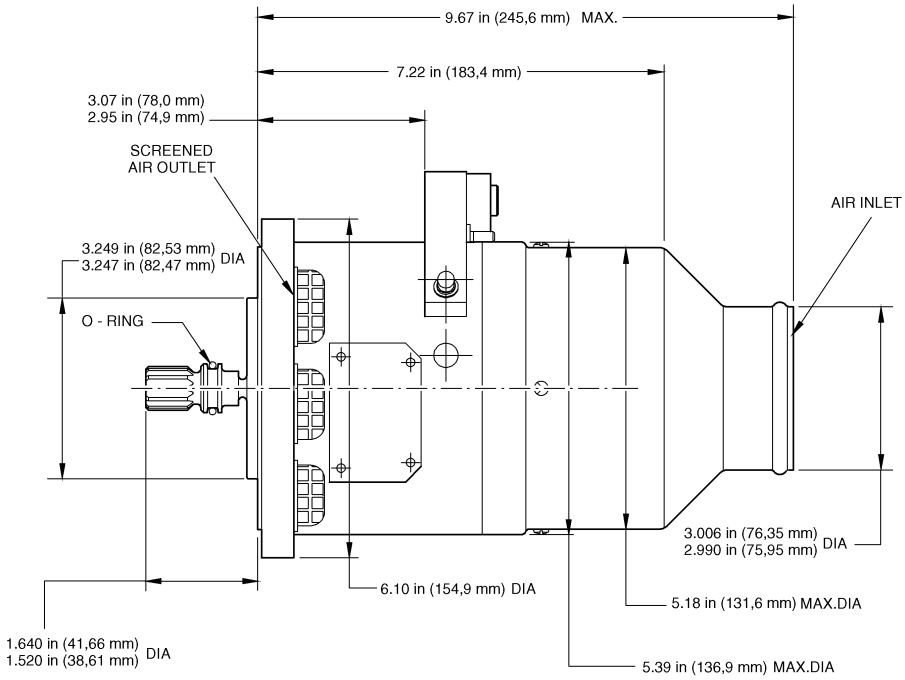

Figure 8 - Outline Drawing 23032-054

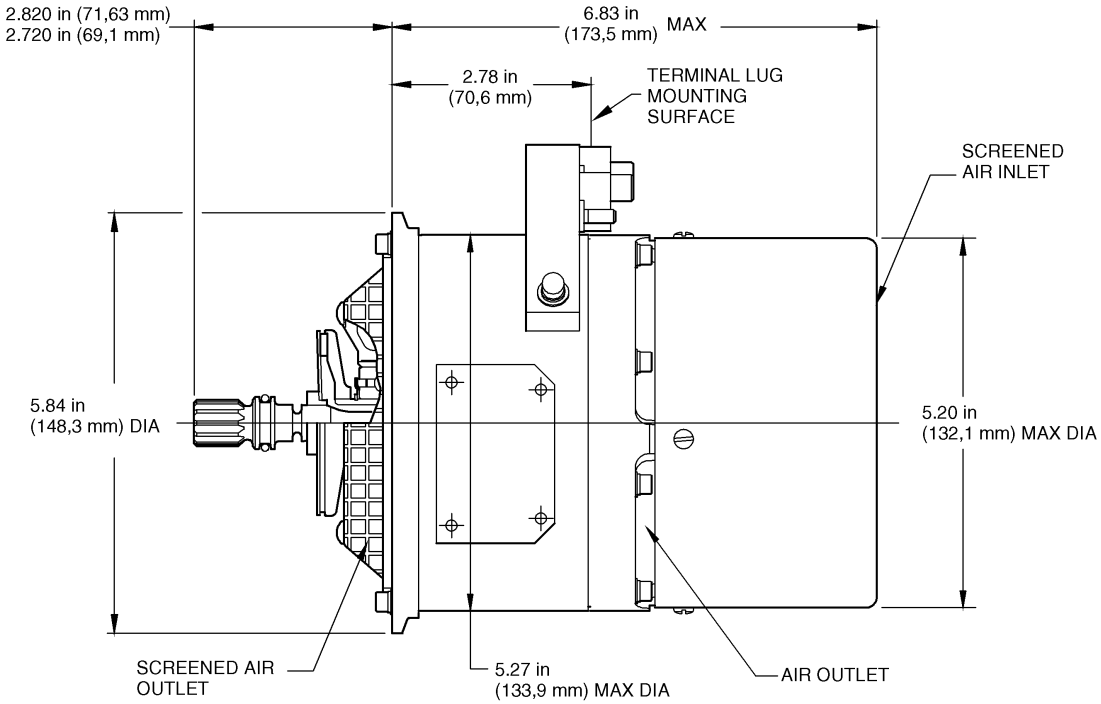

Figure 9 - Outline Drawing 23032-062

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TESTING AND FAULT ISOLATION

1. Introduction

The procedures provided in this section are performance tests and are classified as either verification tests or acceptance tests. A verification test is conducted to assist in fault isolation or to confirm the cause for removal before the repair or overhaul of the DC Starter-Generator. An acceptance test is conducted after the repair or overhaul of the unit. Record all test results on a photocopy of the data sheet(s) provided at the end of this section.

Verification Testing: A starter-generator requiring confirmation of the cause for removal or qualification for continued service must be inspected as detailed in Paragraph 3.A. of the CHECK section before testing can begin. A unit that passes initial inspections may be tested in accordance with this section to determine performance or to isolate a particular fault. When a fault is identified during testing, refer to the fault isolation tables in this section to determine the probable cause.

Acceptance Testing: A unit that has been overhauled or repaired and is ready to be returned to service must be tested in accordance with this section to verify minimum performance standards. Only when an acceptance test is fully completed, and in the order presented in this section, can zero operating hours time since overhaul (TSO) be assigned to an overhauled unit.

2. Test Conditions

Refer to Table 1001 for a list of performance test conditions. Unless otherwise specified, all of the parameters in Table 1001 apply to a test.

Parameter	Operating Condition
Ambient Temperature	50° to 104° F (10° to 40° C)
Barometric Pressure	27 to 33 inch (690 to 840 mm) of mercury
Mounting	Drive shaft (rotational axis) horizontal
Cooling	Self-cooling
Brush Seating Procedures	Refer to Safran Power Standard Practice Document (SPD) 1006 for brush installation, seating, and run-in procedures.

Table 1001 - Performance Test Conditions

WARNING: **DURING GENERATOR OPERATION, THE STARTER- GENERATOR CAN PRODUCE A HIGH OUTPUT CURRENT THAT CAN CAUSE SEVERE SHOCK OR DEATH. MAKE SURE ALL POWER IS SHUT OFF TO THE STARTER-GENERATOR BEFORE REMOVING OR REPLACING TEST EQUIPMENT, INSTRUMENTS, OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING “LIVE CIRCUIT” TESTS AND FAULT ISOLATION PROCEDURES.**

3. Required Test Equipment

Refer to Table 1002 for a list of special tools, fixtures and equipment needed for testing and fault isolation. Equivalent substitutes can be used for items listed.

NOTE: All calibrated equipment, meters and scope indicators used in the testing of this unit should be certified and calibrated in accordance with ISO 10012-1, or should have current calibration traceable to a National Bureau of Standards (NBS) standard. If properly calibrated equipment is not available, the Unit Under Test (UUT) should be sent to an authorized Safran Power repair facility for all the procedures in this manual.

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Setup Reference
Commutation Viewing Adapter	SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section	Figure 9013
Dial Indicator with ball or mushroom indicator tip.	Accuracy: 0.0001 inch Optional: Magnetic Base to fit dial indicator	Not illustrated
Drive Test Stand	Capable of driving starter- generator 6000 to 14,000 rpm	Not Illustrated
High Potential Tester	250 VAC rms, 50 to 60 Hz	Not Illustrated
Ohmmeter	-	Not Illustrated
Oscilloscope, Dual Tone	Digital: Bandwidth of 100 MHz, Sampling Rate of 100ms/second Analog: Bandwidth of 60 to 100 MHz	Not Illustrated
Power Supply, DC, Variable	0 to 30 VDC	Not Illustrated
QAD Mounting Kit (See IPL)	-	Not Illustrated
Starter Test Stand	Capable of measuring a locked rotor torque of 10 lbf.ft and having a power supply capacity of 500 ADC at 22 V	Not Illustrated

Table 1002 - Test Equipment Requirements and Specifications

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Setup Reference
Thermometer or equivalent temperature measuring device	Range: 65 to 300° F (18 to 150° C) Accuracy: ± 1° F (± 0.5° C)	Not Illustrated
Ammeter, DC	0 to 500 A	A_1
Load Bank, Variable	30 V, 0 to 160 A	Variable Load Bank
Regulator, Voltage	Range: 0 to 36 VDC	Voltage Regulator
Resilient Cradle (with foam rubber cushion and restraining strap)	-	Not Illustrated
Shunt, Precision	500 A, 50 mV DC	SH_1
Switch, Generator Load	Rating: 30 V, 300 A	SW_1
Switch, Shunt Field	Rating: 30 V, 10 A	SW_2
Switch, Voltage Regulator	Rating: 30 V, 10 A	SW_3
Vibration Meter	-	Not Illustrated
Voltmeter, DC	Range: 0 to 30 VDC Accuracy: ± 1% of reading	V_4
Voltmeter, DC	Range: 0 to 50 mV DC Accuracy: ± 1% of reading	V_1
Voltmeter, DC	Range: 0 to 50 VDC Accuracy: ± 1% of reading	V_2, V_3

Table 1002 - Test Equipment Requirements and Specifications (Continued)

4. Generator Thermal Stabilization

Stabilization is reached when either of the following conditions is met:

- Temperature of shunt field winding (A-E), as determined by its resistance, rises no more than 2° F (1,1° C) in five minutes.
- Frame temperature measured on side opposite terminal block, does not rise more than 2° F (1,1° C) in five minutes.

5. Test Condition Setpoint Tolerances

Test condition setpoint must be set within tolerances indicated in Table 1003, exclusive of measurement accuracy.

Parameter	Test Condition Setpoint Tolerance
Speed (rpm)	±20 rpm
DC Voltage	±0.1 Vdc
DC Current	±2.5 A
Cooling Air Pressure	±0.2 inch (5,1 mm) - water
Torque	±1.0 lb-ft

Table 1003 - Setpoint Tolerances

6. Test Preparation

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Perform an initial inspection

Perform an initial inspection of the starter-generator in a brightly lit work area to determine its overall condition. Parameters for this initial inspection are given in the CHECK section.

B. Check brush seating

NOTE: In a starter-generator being prepared for verification testing, installed brushes may or may not require brush seating.

CAUTION: THE STARTER-GENERATOR MUST BE SUPPORTED AT ALL TIMES DURING INSTALLATION AND REMOVAL. DO NOT ALLOW THE UNIT TO HANG UNSUPPORTED. EXCESSIVE BENDING LOADS ON THE DRIVE SHAFT CAN DAMAGE THE SHEAR SECTION.

(1) Make sure all brushes (100) are correctly seated according to procedures in SPD 1006.

C. Install starter-generator onto drive stand

(1) Install appropriate QAD kit end bell drive end pad onto drive stand. Refer to ILLUSTRATED PARTS LIST.

(2) While supporting anti-drive end of starter-generator, align and install drive end to end bell drive end pad.

(3) Make sure that drive stand and starter-generator mating splines are correctly engaged.

(4) Install rim-clenching clamp and tighten self-locking hex nut to the value stamped on the clamp.

(5) Turn OFF all power to drive stand.

(6) Connect starter-generator to test circuit as shown in Figure 1001.

(7) Figure 1002 shows, in schematic diagram form, the electrical connections to the starter-generator.

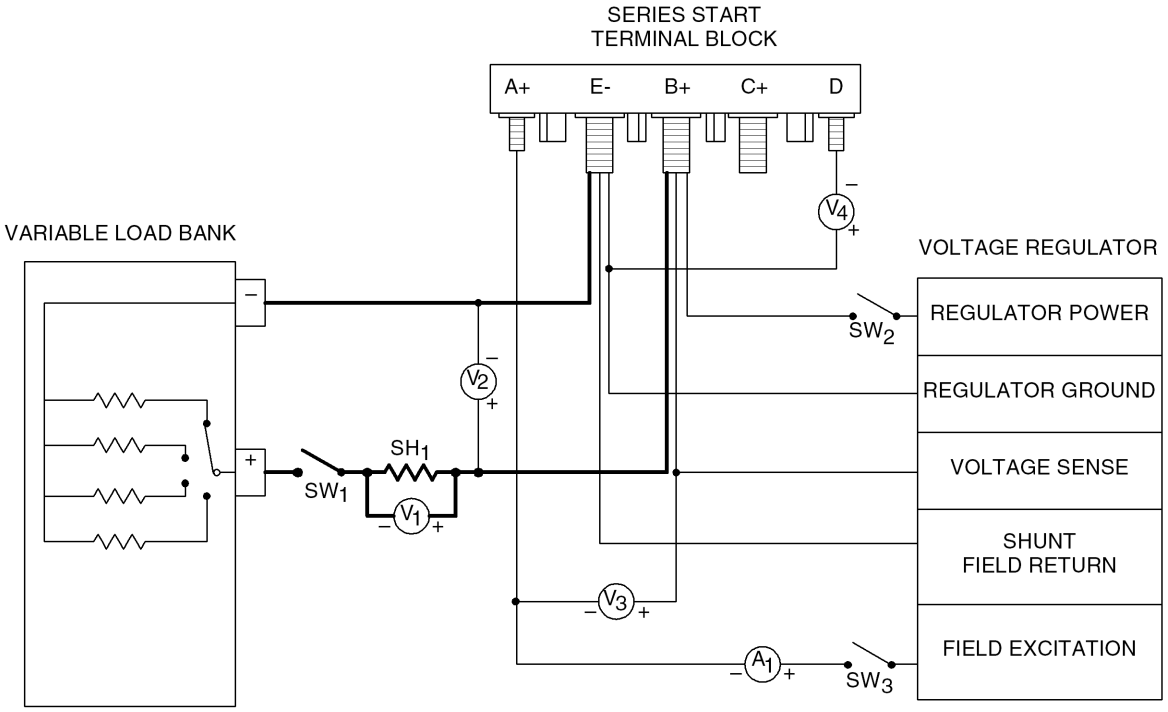


Figure 1001 - 23032 Series DC Starter-Generator Test Set-Up

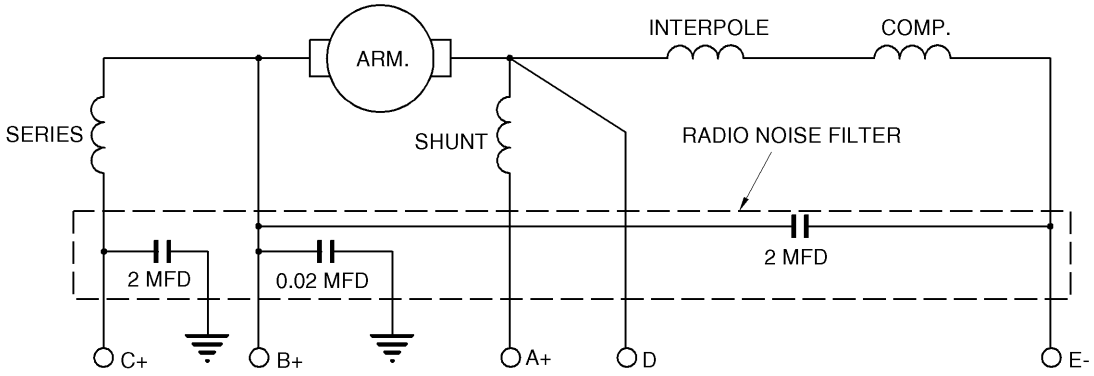


Figure 1002 - Electrical Connections

7. Test Procedures

This Paragraph contains the required performance tests and the sequence in which they are to be accomplished.

WARNING: **MAKE SURE THAT ALL POWER IS SHUT OFF TO THE STARTER-GENERATOR BEFORE REMOVING OR REPLACING COMPONENTS OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE" CIRCUIT TESTS AND TROUBLESHOOTING PROCEDURES. DURING OPERATION, THE STARTER-GENERATOR PRODUCES A VERY HIGH AMPERAGE OUTPUT THAT CAN CAUSE SEVERE SHOCK OR DEATH.**

CAUTION: IF AN ACCEPTANCE LIMIT IS EXCEEDED BY EVEN A SMALL MARGIN, DO NOT CONTINUE FURTHER TESTING OF STARTER-GENERATOR. BE AWARE THAT TESTING OF A DC STARTER-GENERATOR BY ANY LIMIT AFTER IT HAS EXCEEDED THAT LIMIT CAN DAMAGE THE STARTER-GENERATOR.

A. Maximum Speed for Regulation

NOTE: Perform this test without operational warm-up.

(1) With regulator connected to the starter-generator, operate the starter-generator self-excited with no load, at the following RPM and voltage.

Model	RPM	VDC (V_2)
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	12,500	28.5
23032-010, 23032-011, 23032-018, 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	13,000	30

(2) Record the following:

- field current
- commutation (Models 23032-010, -011 and -018 only)
- frame temperature

(3) Commutation acceptance limit (Models 23032-010, -011 and -018 only):

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush.

(4) Shunt field current must not be less than 0.81 A (A_1).

B. Continuous Operating Speed and Equalizing Voltage

(1) Install a thermocouple (or other temperature measuring device) to the outside of the stator and housing assembly in an area adjacent to a stator main pole.

(2) Install a second thermocouple in air inlet opening.

(3) With regulator connected to starter-generator, operate starter-generator at the following RPM, voltage, and ampere load. Stabilize for 15 minutes for models 23032-010, -011, -018, -025, -026, -027, -028, -042, -043, -044, -048 and -049. Operate until stabilized (refer to Paragraph 4.) for models 23032-045, -046, -047, -051, -052, -054 and -062.

Model	RPM	VDC (V_2)	Ampere Load (V_1/SH_1)
23032-010, 23032-011, 23032-018	12,000	30	150
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	12,100	28.5	150
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	12,100	30	160

(4) Record the following:

- voltage between terminals D and E,
- field current,
- air inlet temperature,
- frame temperature,
- commutation (Models 23032-010, -011, -018, -025, -026, -027, -028, -042, -043, -044, -048 and -049 only).

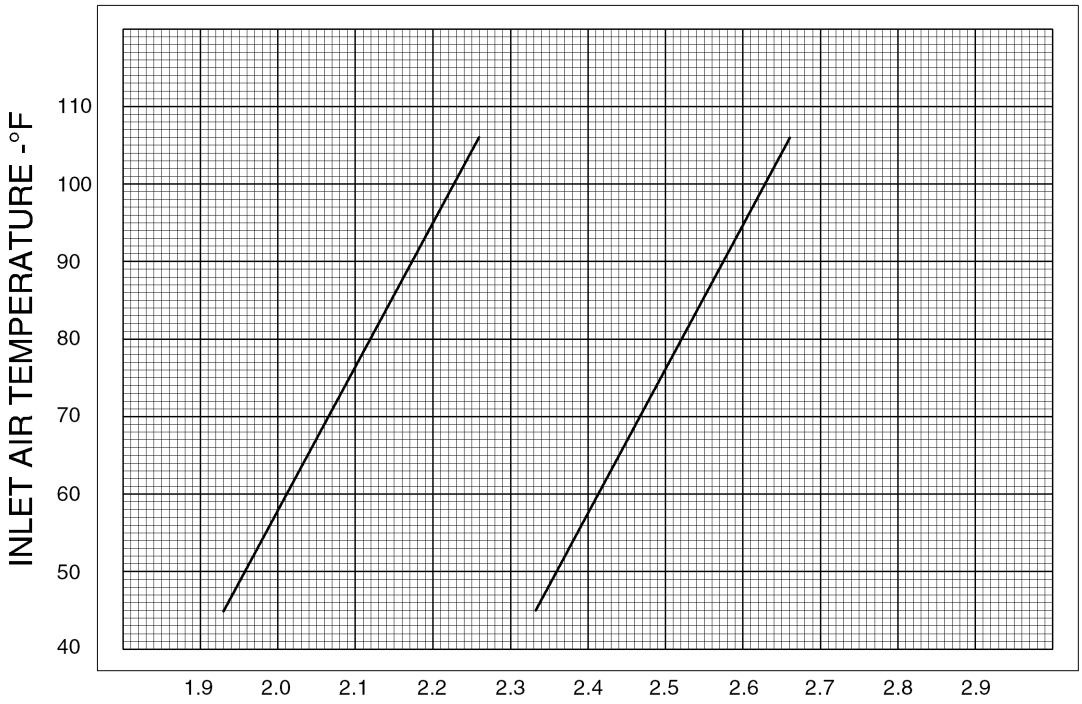
(5) Frame temperature must not exceed air inlet temperature by more than the temperatures listed in the following table.

Model	Maximum Frame-to-Air Inlet Temp Difference
All models	175° F (79.4° C)

(6) The equalizing voltage between terminals D and E must not exceed the value listed in the following table. If voltage is not within limits, refer to Fault Isolation Table 1004 for possible remedies.

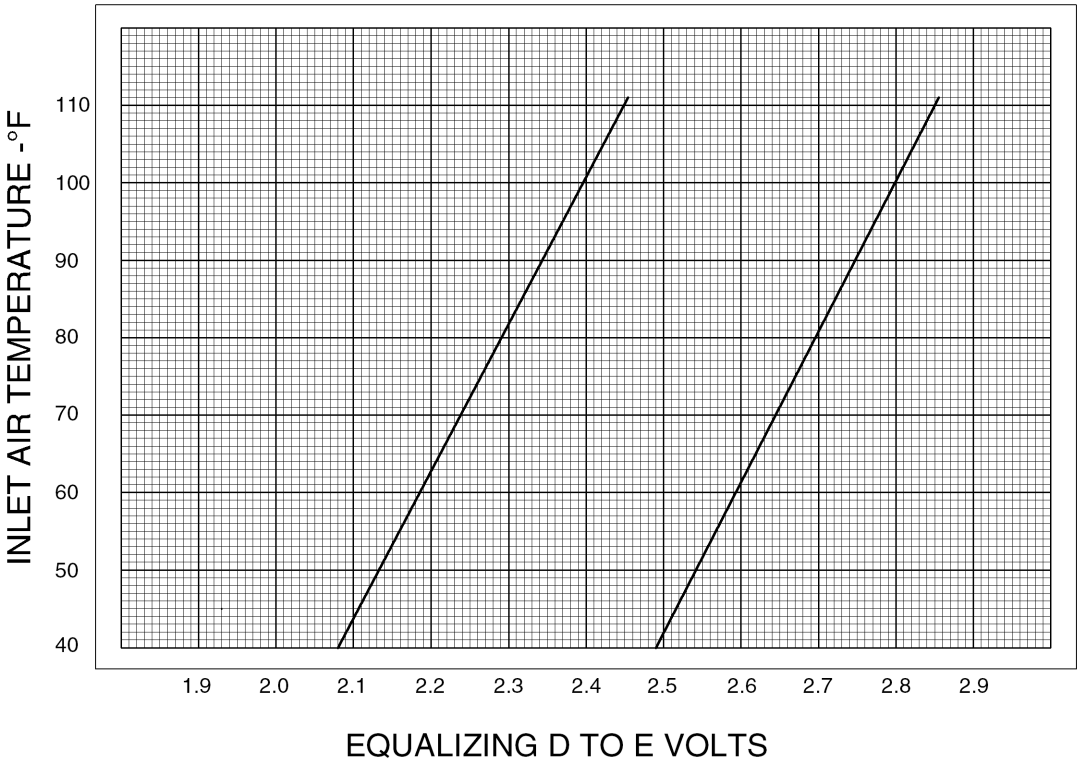
Model	D-E Maximum Voltage (V_4)
23032-010, 23032-011, 23032-018	2.6
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	See Figure 1003
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	See Figure 1004

NOTE: In Figure 1003 and Figure 1004, the left graph line is the minimum range and the right line is the maximum range. An acceptable voltage falls between the two lines on the graph.



Models 23032-025, -026, -027, -028, -042, -043 -044, -048 and -049

Figure 1003 - Equalizing Voltage



Models 23032-045, -046, -047, -051, -052, -054 and -062

Figure 1004 - Equalizing Voltage

(7) Commutation acceptance limits (Models 23032-010, -011, -018, -025, -026, -027, -028, -042, -043, -044, -048 and -049 only).

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush.

C. Compounding

(1) Operate starter-generator with the regulator connected, at the following RPM and voltage. Incrementally apply ampere loads as noted in the table.

Model	RPM	VDC (V_2)	Ampere Loads
23032-010, 23032-011, 23032-018	12,000	30	0, 37, 75, 112, 150
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	12,100	28.5	0, 37, 75, 112, 150
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	12,100	30	0, 40, 80, 120, 160

(2) Record field current for each load.

(3) Field current must rise with increasing load.

(4) Commutation acceptance limits (Applies to models 23032-010, -011 and -018 only):

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush.

D. Minimum Speed for Regulation

(1) Operate starter-generator at the following RPM, voltage, and ampere load (stabilization not required).

Model	RPM	VDC (V_2)	Amp Load (V_1/SH_1)	Max. Field Current (A_1)	Min. B-A Ω
23032-010, 23032-011, 23032-018	8,700	30	150	8 A	N/A
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	8,100	28.5	140	10 A	N/A
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	8,400	30	160	10 A	0.5

(2) Record the field current. Field current must not exceed amperage specified in table above.

(3) For those models in the table above that require the B-to-A resistance check, record voltage between B and A terminals.

Calculate resistance between terminals B and A using the following formula. Resistance between B and A must not be less than ohms (Ω) specified in above table.

$$\text{B-A Resistance} = \frac{\text{B-to-A Voltage}}{\text{Field Current}}$$

(4) Commutation acceptance limits (Applies to models 23032-010, -011 and -018 only):

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush.

E. Minimum Speed

(1) With regulator or variable resistor connected to the starter-generator field circuit, operate starter-generator at the following RPM and voltage.

Model	RPM	VDC (V_2)	Amp Load (V_1/SH_1)	Max. Field Current (A_1)	Min. B-A Ω
23032-010, 23032-011, 23032-018	8,100	26	150	8 A	1.25
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	7,200	26	125	10 A	0.5
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	7,700	26	160	10 A	0.5

(2) Record the following:

- speed
- field current

- frame temperature
- voltage between B and A terminals

(3) Field current must not exceed amperage values listed in the table above.

(4) Resistance in external field circuit (between B & A) must not be less than resistance specified in table above. Calculate resistance between terminals B and A using the following formula.

$$\text{B-A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

(5) Commutation acceptance limits (Applies to models 23032-010, -011 and -018 only):

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush.

F. Commutation

(1) Operate starter-generator with regulator connected, at the voltage, ampere loads, and speed increments listed in the following table.

(2) Check commutation by applying all three loads, at each speed listed.

Model	VDC (V_2)	Speed Increments (RPM)	Load Increments (A) (V_1/SH_1)
23032-010, 23032-011, 23032-018	30	8,700, 10,000, 12,000	0, 75, 150
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	30	12,100	80, 160

(3) Record the worst condition for commutation.

(4) Commutation acceptance limits:

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush.

G. Overspeed Test

(1) With field circuit open and starter-generator still hot from testing, operate unit at 14,000 RPM for five (5) minutes. There must be no signs of mechanical failure.

(2) Reduce speed to the value in the following table and run at the voltage and current loads listed.

Model	VDC (V_2)	Speed (RPM)	Load (A) (V_1/SH_1)
23032-010, 23032-011, 23032-018	30	12,000	150
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	28.5	12,100	150
23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	30	12,100	150

(3) Record the following:

- commutation

(4) Commutation acceptance limits:.

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

(b) Unacceptable commutation is considered to be continuous sparking or “arcing” that extends 0.25 inch (6,4 mm) beyond the edge of the brush

H. Dielectric Test

WARNING: BEFORE USING HIGH VOLTAGE TESTER, MAKE CERTAIN TESTER HAS BEEN TURNED “OFF” AND THAT NO ONE IS TOUCHING ANY PORTION OF CONNECTION POINTS OR PROBE LEAD WIRES. FAILURE TO COMPLY WITH THIS WARNING CAN RESULT IN SEVERE ELECTRIC SHOCK TO THE OPERATOR OR ASSISTANTS.

CAUTION: DO NOT DO DIELECTRIC TESTING ON A MACHINE THAT HAS NOT BEEN FULLY CLEANED.

CAUTION: CAPACITORS IMBEDDED IN RADIO NOISE FILTERS IN THE TERMINAL BLOCK AND FILTER BOARD ASSEMBLIES (IF PRESENT) WILL BE DAMAGED IF SUBJECTED TO DIELECTRIC TEST. ALWAYS DISCONNECT STATOR LEADS FROM TERMINAL BLOCK AND FILTER BOARD ASSEMBLY LEADS (IF PRESENT) FROM THE ANTI-DRIVE BEARING RETAINER WHEN CONDUCTING DIELECTRIC TEST.

(1) While still hot from testing, remove power from tester and remove starter-generator from test stand.

(2) Disconnect stator leads from stator and housing terminal block and reconnect stator leads to a dummy terminal block.

NOTE: Alternatively, if the original terminal block is used, the grounding lead screw can be removed and the grounding lead must be protected with electrical tape.

(3) (Models 23032-045, -046, -047, -051, -052, -054, and -062)
At anti-drive end bell, remove two bearing retainer screws that attach two filter board assembly leads to the bearing retainer. Disconnect and isolate leads.

(4) Conduct hi-potential tests, terminal-to-frame, by applying 250 VAC, 60 Hz for one minute, as follows:

Terminal-to- Frame Checks
Test Lead 1 to generator frame. Test Lead 2 to each terminal (A, B, C, D, and E)

(5) Any arcing as evidenced by flashover (surface discharge), sparkover (air discharge) breakdown (puncture discharge) or leakage current more than 5mA will be evidence of damp, dirty, weak or defective components.

(6) Disconnect dummy terminal block and reconnect stator leads to the starter-generator terminal block, or replace the screw that attaches the grounding lead.

NOTE: Make sure to remove any electrical tape that was used on the grounding lead.

(7) (Models 23032-045, -046, -047, -051, -052, -054, and -062) Reconnect brush filter board leads to anti-drive end bearing retainer.

(8) Re-install starter-generator onto test stand.

I. Locked Rotor Test (For models 23032-010, -011, -018, -045, -046, -047, -051, -052, -054, -062)

(1) Re-install starter-generator onto test stand and lock the rotor.

NOTE: Make sure starter-generator is properly mounted by its flange and shunt field (A+) is open (no connection).

(2) Before turning on power supply, set power supply output to minimum.

CAUTION: DO NOT ENERGIZE STARTER-GENERATOR MORE THAN 2 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER EXCEEDS VOLTAGE AND AMPS OF ACCEPTABLE LIMITS.

(3) Turn ON power supply.

(4) With no load applied, gradually increase the voltage between terminals C and E until output torque is as specified in the following table.

Model	Torque lbf.ft	Maximum VDC	Maximum Current
23032-010, 23032-011, 23032-018, 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	9	22	380 A

(5) At 9 lbf.ft of torque, current and voltage must not exceed values specified in the table above.

J. Locked Rotor Test (For models 23032-025, -026, -027, -028, -042, -043, -044, -048, -049)

(1) Re-install starter-generator onto test stand and lock the rotor.

NOTE: Make sure starter-generator is properly mounted by its flange and shunt field (A+) is open (no connection).

(2) Before turning on power supply, set power supply output to minimum.

CAUTION: DO NOT ENERGIZE STARTER-GENERATOR MORE THAN 4 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER EXCEEDS VOLTAGE AND AMPS OF ACCEPTANCE LIMITS.

(3) Turn ON power supply.

(4) With no load applied, gradually increase the voltage between terminals C and E until output torque is as specified in the following table:

Model	Torque lbf.ft	Maximum VDC	Maximum Current
23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	9	15	300 A

(5) At 9 lbf.ft of torque, current and voltage must not exceed values specified in the table above.

K. Starter Test (For models 23032-010, -011, -018, -045, -046, -047, -051, -052, -054, -062)

(1) Remove power from tester.

(2) Mount the unit on a starter stand and connect starter-generator as shown in Figure 1005.

NOTE: Make sure starter-generator is properly mounted by its flange and shunt field (A+) is open (no connection).

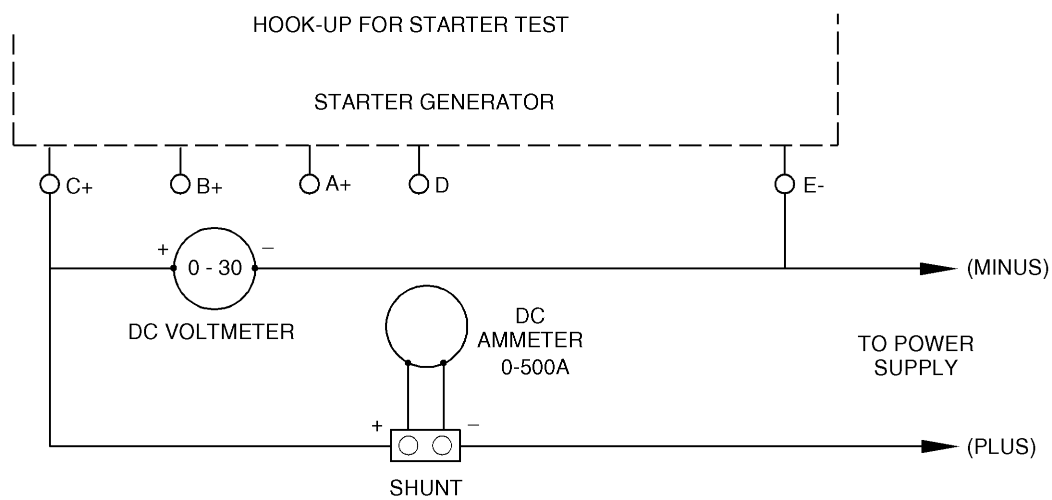


Figure 1005 - Starter Test Set-Up

(3) Before turning on power supply, set power supply output to minimum.

(4) Turn ON power supply.

(5) With no load, gradually increase starter voltage between terminals C and E until voltage reaches 23 VDC.

(6) At 23 VDC the no-load speed must be equal to or greater than 6,100 RPM.

(7) Turn power supply OFF.

(8) Remove starter-generator from the test stand.

L. Starter and Vibration Test (For models 23032-025, -026, -027, -028, -042, -043, -044, -048, -049)

CAUTION: MAKE SURE STARTER-GENERATOR IS RESTRAINED DURING INITIAL STARTUP.

(1) Mount starter-generator in a resilient cradle (foam rubber cushioned) with the drive shaft supported (centered).

(2) Connect starter-generator as shown in Figure 1005.

(3) With no load, gradually increase starter voltage between terminals C and E until voltage reaches 20 VDC.

(4) At 20 VDC the no-load speed must be equal to or greater than 9,200 RPM.

(5) With a vibration meter, measure and record total frame vibration amplitude.

(6) Acceptance limits:

(a) Total frame deflection must not be more than 0.001 inch (0,03 mm).

(7) Turn power supply OFF.

(8) Remove starter-generator from resilient cradle.

M. Commutator Run-Out

CAUTION: DO NOT TOUCH THE POLISHED COMMUTATOR SURFACE WITH BARE HANDS. SKIN ACIDS AND OILS CAN CONTAMINATE CONDUCTING SURFACES, CAUSING CORROSION OR POOR ELECTRICAL CONTACT.

(1) Remove the commutation viewing adapter from the starter-generator.

(2) Put the starter-generator in a V-block or cradle support.

(3) Make sure there is sufficient access for the dial indicator to touch the commutator surface.

NOTE: You can get access to the commutator by removing one of the brushes from the brush holder or by finding an access area between the brush holders to do the measurement.

(4) Put the tip of the dial indicator on the brush wear path on the commutator surface.

NOTE: Make sure the dial indicator is perpendicular to the commutator surface.

(5) Install a spline wrench on the drive shaft.

(6) Turn the drive shaft by applying constant turning force in the direction of rotation of the starter-generator.

(7) Measure bar-to-bar and total indicator reading (TIR) runout in the full circumference of the commutator.

(8) Acceptance Limits:

(a) Bar-to-Bar Runout: 0.0002 inch (0,005 mm) Maximum.

(b) Total Runout: 0.0007 inch (0,015 mm) Maximum.

8. Fault Isolation Table

Table 1004 lists faults that may occur during acceptance testing, performance testing, or while in service. For each fault, probable causes are listed along with related corrective actions. When a fault is detected, perform corrective actions necessary to return starter-generator to a serviceable condition. A complete acceptance test is required after corrective action is accomplished.

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Unit fails to operate or does not attain normal speed.	Low voltage power source.	Check power source to make certain that full voltage is being applied to starter-generator terminals.
	Defective switch in power supply line.	Replace switch.
	Damaged armature.	Replace armature.
	Short circuited or open stator windings.	Replace stator assembly.
	Improperly seated brushes.	Check brush seats and accomplish brush seating. Refer to REPAIR section for brush seating instructions.
	Eccentric commutator.	Refinish commutator.
Excessive sparking at brushes.	Short circuited or grounded field windings.	Replace stator assembly.
	Excessive clearance in bearings or rough bearing races.	Replace bearings.
	Damaged or eccentric commutator	Refinish commutator. Refer to REPAIR section for commutator refinishing instructions.
	Armature out of balance	Balance or replace armature.
	Short circuit in armature windings.	Replace armature.
	Brushes incorrectly installed with top bevel reversed.	Reverse and reseat brushes. Refer to REPAIR section for brush seating instructions.
	Severe overload or short circuit in electrical system.	Locate and correct fault.
	Brushes sticking in holders.	Free-up brushes. Refer to REPAIR section for brush spring tension checks and brush replacement instructions.

Table 1004 - Fault Isolation Table

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy operation.	Weak brush springs.	Replace brush springs.
	Rough bearings.	Replace bearings.
	Scored or worn drive splines.	Replace drive shaft.
	Armature rubbing in stator.	Repair or replace defective parts.
	Fan blades bent and rubbing.	Replace fan assembly.
Unit vibrates.	Unbalanced armature.	Balance or replace armature. Refer to REPAIR section for armature balancing instructions.
	Excessive run-out of armature bearings.	Replace armature bearings.
	Fan out of balance or damaged fan blades.	Replace fan assembly
Starter-Generator produces full voltage but with reversed polarity.	Voltmeter leads reversed.	Connect voltmeter correctly. See Figure 1001.
	Residual magnetism in field poles creates wrong polarity.	Flash the field. Refer to REPAIR section for field flashing instructions.
Starter-Generator overheats (frame temperature 175° F (80° C). in excess of inlet air temperature).	Continuous overload or restricted air inlet.	Check electrical test set-up for grounds, etc. Make corrections as necessary. See Figure 1001.
D to E equalizing voltage not within limits specified in Paragraph 7.B.(6).	Insufficient cooling air.	Check for air inlet temperature as required per Table 1001.
	Air flow obstruction.	Dirt accumulation in generator ducting. Check ducting and generator air inlet.
	Wrong load applied during testing.	Check testing procedure and correct condition.
Starter-Generator fails starting test.	Short circuited or open stator winding.	Replace stator assembly.
	Open circuit in armature.	Replace armature.
EMI fault suspected.	Bad capacitor in terminal board.	Replace terminal board or potted capacitors.

Table 1004 - Fault Isolation Table (Continued)

Verification/Final Acceptance Data Sheet

Model Number: **23032 -** Inspected by: _____

Serial Number: _____ Date: _____

Inspection/Test	Requirements/Limits	Measure	Accept	Reject
Visual Inspection	Check for physical damage			
Brush Seating	Brushes must be seated 100% in direction of rotation, and at least 90% in axial direction.			
Maximum Speed for Regulation Test	Shunt field current not less than 0.81 A.	A		
	Commutation must not exceed pinpoints (23032-010, -011, -018)			
Continuous Operating Speed and Equalizing Voltage Test	Frame temperature must not exceed air inlet temperature by more than value specified in Paragraph 7.B.(5).	T		
	Equalizing voltage must be within limits specified in Paragraph 7.B.(6).	V		
	Commutation must not exceed pinpoints (23032-010, -011, -018, -025, -026, -027, -028, -042, -043, -044, -048, -049)			
Compounding	Field current must rise with increasing load.	A		
	Commutation must not exceed pinpoints. (23032-010, -011, -018)			
Minimum Speed for Regulation Test	(B to A) resistance must not be less than value specified in Paragraph 7.D. table.	Ω		
	Field current must not exceed current value specified in Paragraph 7.D. table.	A		
	Commutation must not exceed pinpoints. (23032-010, -011, -018)			
Minimum Speed Test	Field current must not exceed current value specified in Paragraph 7.E. table.	A		
	(B to A) resistance must be a minimum of value specified in Paragraph 7.E. table.	Ω		
	Commutation must not exceed pinpoint sparking. (23032-010, -011, -018)			

Inspection/Test	Requirements/Limits	Measure	Accept	Reject
Commutation (23032-010, -011, -018, -045, -046, -047, -051, -052, -054, -062)	Commutation must not exceed pinpoints at any speed or load specified in Paragraph 7.F.			
Overspeed Test	No evidence of mechanical failure.			
	Commutation points must not exceed pinpoints.			
Dielectric Test	No evidence of insulation breakdown is acceptable.			
Locked Rotor Test	At 9 lbf.ft., voltage and current must not exceed values specified in Paragraph 7.I.(4)). or Paragraph 7.J.(4).	V A		
Starter Test (23032-010, -011, -018, -045, -046, -047, -051, -052, -054, -062)	At voltage specified in Paragraph 7.K.(6), speed must not be less than RPM specified for voltage.	RPM		
Starter and Vibration Test (23032-025, -026, -027, -028, -042, -043, -044, -048, -049)	At voltage specified in Paragraph 7.L.(4) speed must not be less than RPM specified for voltage.	RPM		
	Total frame deflection must not be more than 0.001 inch (0,03 mm)	inch (mm)		
Commutator Runout	Total indicated runout must not exceed 0.0007 inch (0,015 mm)	inch (mm)		
	Bar-to-bar runout must not exceed 0.0002 inch (0,005 mm)	inch (mm)		

SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

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DISASSEMBLY

1. Introduction

This section provides disassembly instructions for 23032 Series of DC Starter-Generators. Additional disassembly of major components is not necessary unless further disassembly is indicated in CHECK or TESTING AND FAULT ISOLATION.

NOTE: Do not open or desolder permanent connections unless replacement of worn, damaged, or defective parts is needed.

NOTE: During overhaul, all bearings, brushes, insulating parts, retaining rings, O-rings, lock washers, and self-locking nuts must be discarded regardless of their condition.

NOTE: When a starter generator is removed for service, the QAD kit usually stays on the aircraft.

2. Disassembly Tools

In addition to standard shop tools, the following tools and fixtures are needed for starter-generator disassembly.

The disassembly tools and fixtures listed below cannot be procured from Safran Power. Equivalent tooling and fixture requirements meeting with Safran Power specifications can be used. Reference SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

Tool Description	Reference
Arbor press	Not illustrated
Bearing hub support	Figure 9001
Spline wrench	Figure 9007
Inner race bearing driver	Figure 9003
Armature shaft adapter, drive end	Figure 9005
Leather or plastic mallet	Commercially available
Retaining ring pliers	Commercially available
Anti-drive end, end bell assembly support	Figure 9010
Armature shaft adapter, anti-drive end	Figure 9012
Foam Cushion	Commercially available
Wire Hook Tool	Commercially available

Table 3001 - Disassembly Tools and Fixtures

3. Disassembly Materials

Materials necessary for starter-generator disassembly are listed in Table 3002.

NOTE: Disassembly materials are not available from Safran Power. All items can be purchased commercially.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source (CAGE Code)
Isopropyl Alcohol See **WARNING** before using this material.	TT-I-735, Grade A Flash Point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for the additional safety information.	Commercially Available
Masking Tape	N/A	Commercially Available

Table 3002 - Disassembly Materials

4. Disassembly

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST.

NOTE: Do not disassemble any of the following components unless they are damaged.

- Anti-drive end bearing and brush support assembly (-370)
- Stator and housing assembly (550)

NOTE: During disassembly, inspect component parts in accordance with procedures in the CHECK section of this manual.

A. Remove QAD kit (650) if attached.

NOTE: The V-Retainer coupling usually stays on the aircraft when the starter-generator is removed for service. Check and inspection of the part is not required if not present.

NOTE: The mounting adapter coupling usually stays on the aircraft when the starter-generator is removed for service. Check and inspection of the part is not required if not present.

(1) Loosen and remove rim-clenching clamp (670).

(2) Remove end bell, drive end pad (660).

B. If damaged or unreadable, remove identification plate (10) information plate (40) decal (30) or FAA-PMA label (-60) as applicable.

NOTE: Do not remove these items unless they are damaged or unreadable.

NOTE: Minor scratches and superficial damage that do not affect the legibility are not reason to replace the ID plate.

NOTE: Record the information from the identification plate before it is removed to make sure the information is not lost by damage during removal.

(1) Use a smooth, flat tool that will not scratch the stator and housing assembly to wedge under the edge of the identification plate (10). Pry up the corners of the plate near to the four drive screws that hold the plate in place to dislodge it from the housing.

NOTE: This will tear the corners of the plate.

(2) Remove the remaining metal from under the heads of the drive screws (20).

(3) Use a small pair of sidecutters, with the flat face to the housing, to hold the shank of the drive screw and turn out counterclockwise.

(4) Repeat Paragraph 4.B.(1) thru Paragraph 4.B.(3) to remove the information plate (40) and drive screws (50).

(5) Use a suitable scraper to remove the decal (30).

NOTE: For models 23032-048 and 23032-049, also replace the FAA-PMA label (-60) if damaged or unreadable.

C. If generator uses a wet spline type drive shaft, remove O-ring (150) and discard.

D. Remove fan cover assembly (70) by removing four screws (80). See Figure 3001.

E. Remove brushes (100) from brush holders (530).

NOTE: If brushes (100) are to be reused, identify the brushes (100) and brush holders (530) with the numbers 1 through 4.

(1) Remove four screws (110) that secure brush and field leads.

CAUTION: RAISE AND LOWER BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO REMOVE BRUSHES FROM EACH COMPLETE BRUSH HOLDER.

(2) Remove four brushes (100) from brush holders.

F. Remove fan assembly (200) from drive shaft (120).

(1) Use a suitable spline wrench to hold drive shaft (120).

(2) Remove self-locking nut (130) and washer (140).

(3) Remove fan assembly (200) from drive shaft (120).

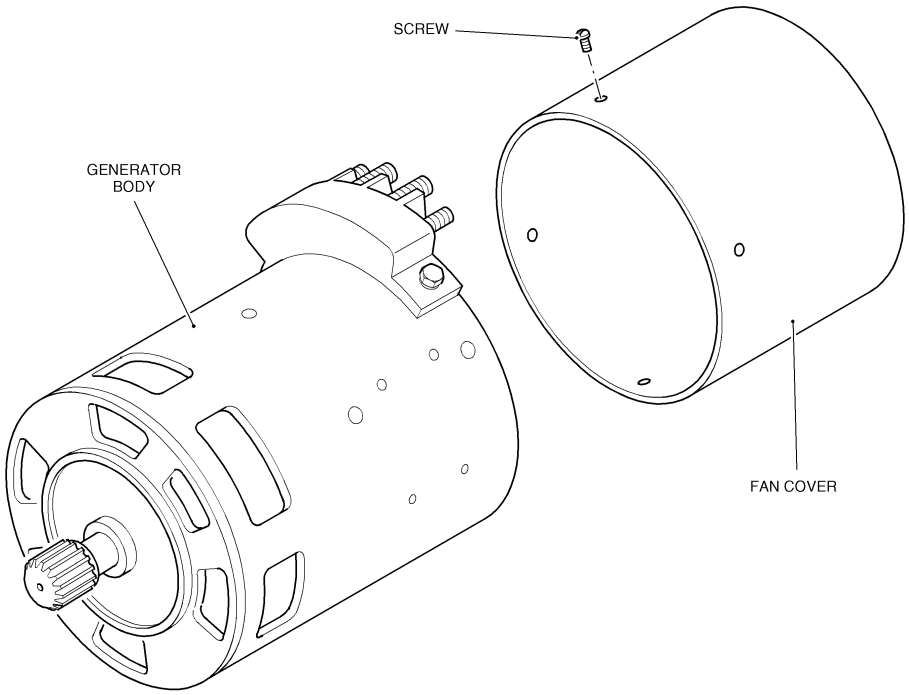

Figure 3001 - Removing Fan Cover

G. Remove drive shaft (120) and associated dampener parts (160, 170, 180 and 190). See Figure 3002.

CAUTION: DO NOT USE A HIGH AMOUNT OF FORCE WHEN YOU TAP THE DRIVE SHAFT. HIGH FORCE CAN DAMAGE THE DRIVE SHAFT THREAD.

(1) Tap drive shaft (120) out of drive end of stator and housing assembly (550) using a plastic or leather mallet.

WARNING: **FRICTION RING MAY CONTAIN ASBESTOS. DO NOT CUT, RIP, OR SAND ASBESTOS-CONTAINING MATERIALS. LEAVE UNDAMAGED MATERIALS ALONE AND, TO THE EXTENT POSSIBLE, PREVENT THEM FROM BEING DAMAGED, DISTURBED, OR TOUCHED. DISCARD MATERIAL BY FIRST CHECKING WITH LOCAL HEALTH, ENVIRONMENTAL, OR OTHER APPROPRIATE OFFICIALS TO FIND OUT ABOUT PROPER HANDLING AND DISPOSAL PROCEDURES.**

(2) Remove dampener plate (170) and friction ring (180). See Figure 3002.

(3) Remove friction ring (180) from drive shaft (120).

(4) If friction ring is P/N: 02-5600-05 it must be discarded because it contains asbestos. Reference SIL 02-5600.

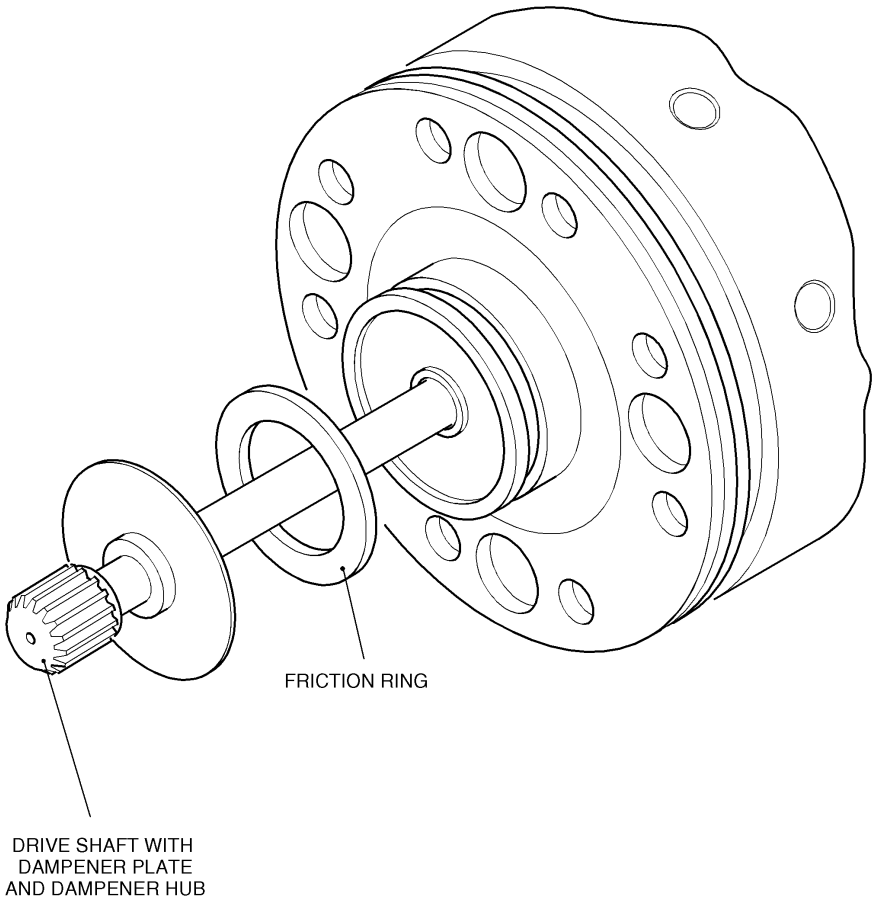

Figure 3002 - Drive Shaft Removal

CAUTION: PUT A FOAM CUSHION UNDER DRIVE SHAFT TO PREVENT IT FROM BEING DAMAGED.

(5) Remove dampener hub (160) from drive shaft only if damaged and replacement is necessary. See Figure 3003.

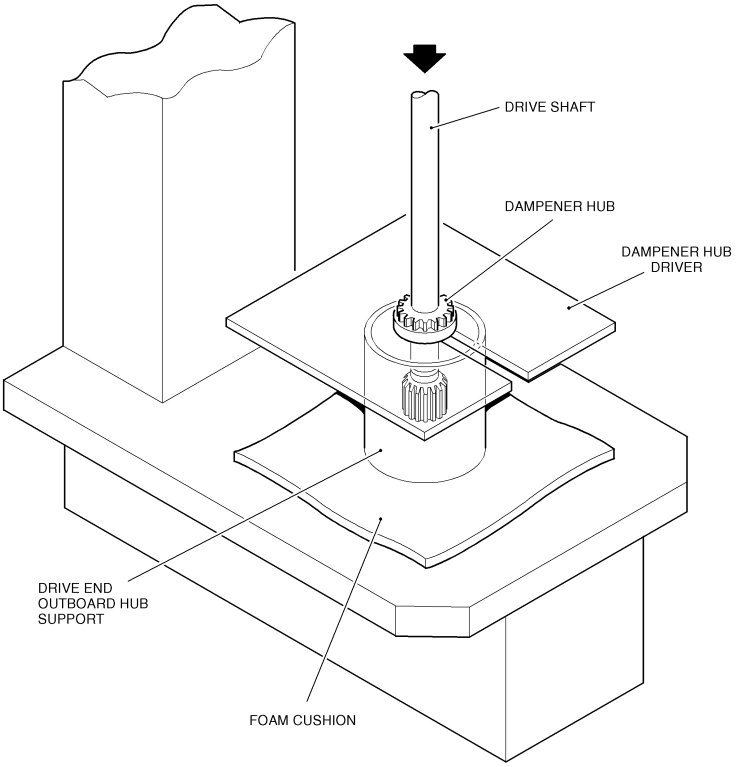

Figure 3003 - Dampener Hub Removal

CAUTION: FAILURE TO USE A DRIVE END ARMATURE SHAFT ADAPTER WHEN REMOVING DAMPENER BACKPLATE CAN CAUSE PERMANENT DAMAGE TO ARMATURE SHAFT.

(6) Put a drive end armature shaft adapter in drive end of armature (330) shaft.

CAUTION: TAPE JAWS OF BEARING PULLER TO PREVENT DAMAGE TO DAMPENER BACKPLATE DURING REMOVAL.

(7) Remove dampener backplate (190) from armature (330) shaft using a suitable bearing puller. See Figure 3004.

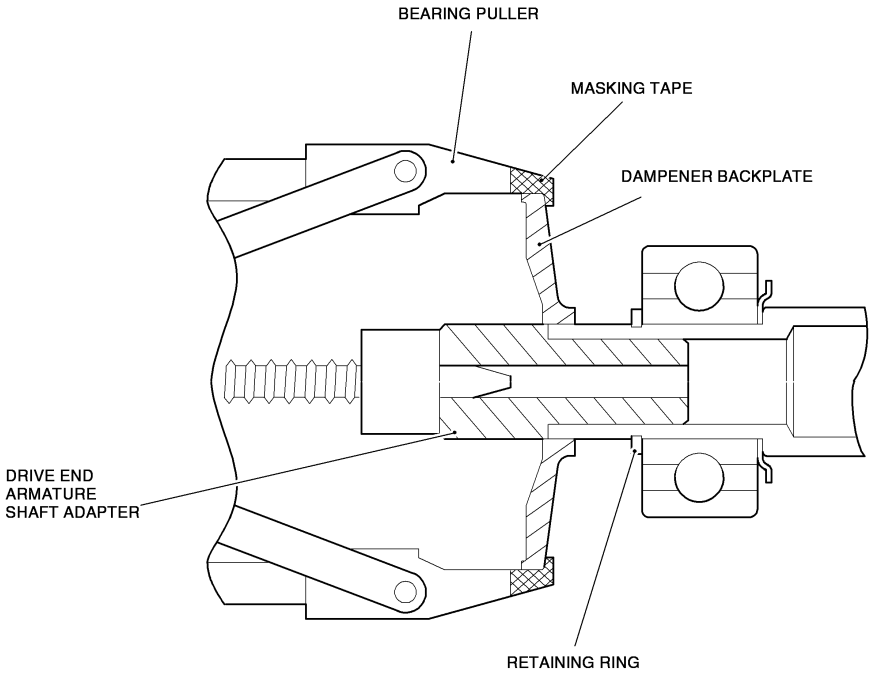

Figure 3004 - Removing Dampener Backplate

H. Remove drive end end bell or drive end bearing support assembly (210).

Drive End End Bell Style	Used on Models
Drive End End Bell 210 to 210C	23032-010, 23032-011, 23032-018, 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054
Drive End Bearing Support Assembly 210D to 210F	23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049, 23032-062

(1) Remove eight screws (220), lock washers (230), and washers (250).

(2) Remove drive end end bell or drive end bearing support assembly (210) from stator and housing assembly (550).

NOTE: Do not remove end bell screen (270) from drive end end bell (260) unless inspection reveals damage and replacement is required.

(3) If screen (270) is damaged, remove drive screws (280) and washers (290) to remove screen.

I. Remove anti-drive end bearing and brush support assembly (-370). See Figure 3005.

(1) Remove eight screws (380), lock washers (390), and washers (410).

(2) Remove anti-drive end bearing and brush support assembly (-370) with assembled armature (330).

J. Separate and remove anti-drive end bell (540) from armature (330). See Figure 3005.

CAUTION: USE AN ANTI-DRIVE END ARMATURE SHAFT ADAPTER WHEN YOU REMOVE THE ANTI-DRIVE END END BELL FROM THE ARMATURE. THIS WILL PREVENT DAMAGE TO THE ARMATURE SHAFT.

(1) Using an anti-drive end end bell assembly (Figure 9010) support, place armature, drive end down, into support until end bell (540) rests on top of support.

(2) Using an armature shaft adapter, anti-drive end (Figure 9012), press armature (330) out of bearing (320).

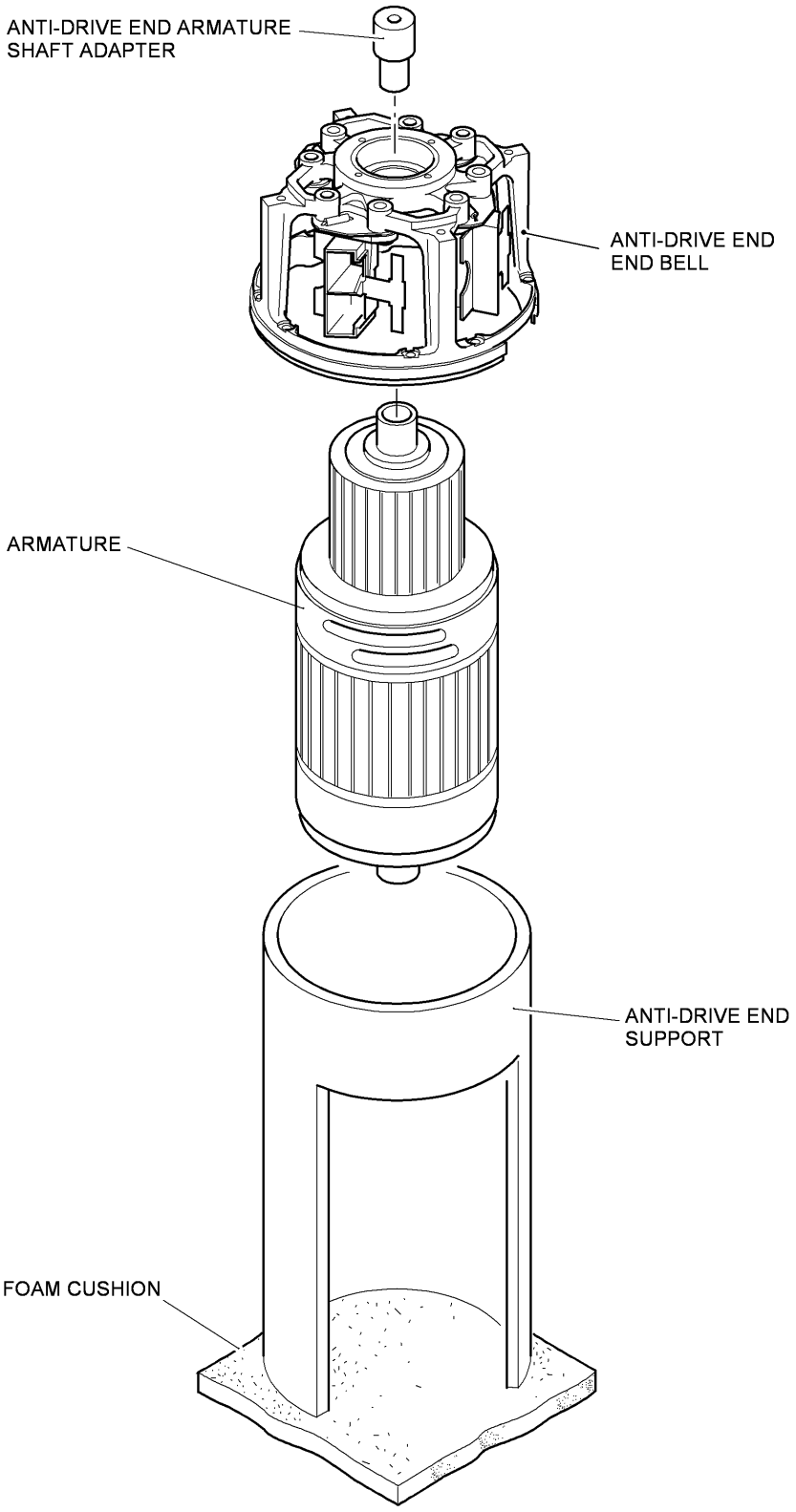

Figure 3005 - Removing Armature from Bearing and Brush Support Assembly

K. Disassemble armature assembly (330).

(1) At drive end of armature, remove retaining ring (300) and baffle disc (310) from the armature shaft.

(2) Using a suitable bearing puller and drive end armature shaft adapter, remove bearing (320) from armature shaft. See Figure 3006.

(3) Remove remaining baffle disc (310) from armature shaft.

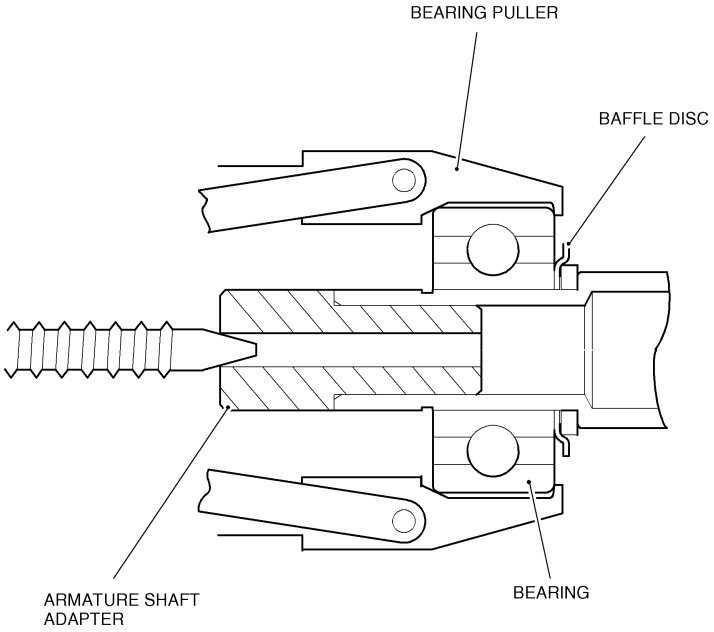

Figure 3006 - Removing Ball Bearing from Armature

L. Disassemble anti-drive end bearing and brush support assembly (370). See Figure 3007.

NOTE: Do not remove brush holder assemblies (420), springs (520), or filter board assembly (450) from anti-drive end bearing and brush support assembly unless inspection reveals that replacement of parts is required.

(1) Remove bearing retainer (340) by removing four screws (350) and lock washers (360).

NOTE: On models 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062, two of the bearing retainer screws and washers secure wire leads from filter board assemblies that are attached to the brush assemblies. In the following steps, ensure that the wire leads are protected from damage.

(2) Using bearing hub support (Figure 9001) and inner race bearing driver (Figure 9003), press ball bearing (320) out of end bell.

(3) If necessary, remove brush holder assemblies (-420), springs (520), and filter board assembly (450) from anti-drive end bearing and brush support assembly as follows. See Figure 3007.

NOTE: The filter board assembly (450) is present only on models 23032-010, 23032-011, 23032-018, 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062.

(a) Remove self-locking nuts (510), screws (430), washers (490), non-metallic washers (500), and non-metallic washers (480).

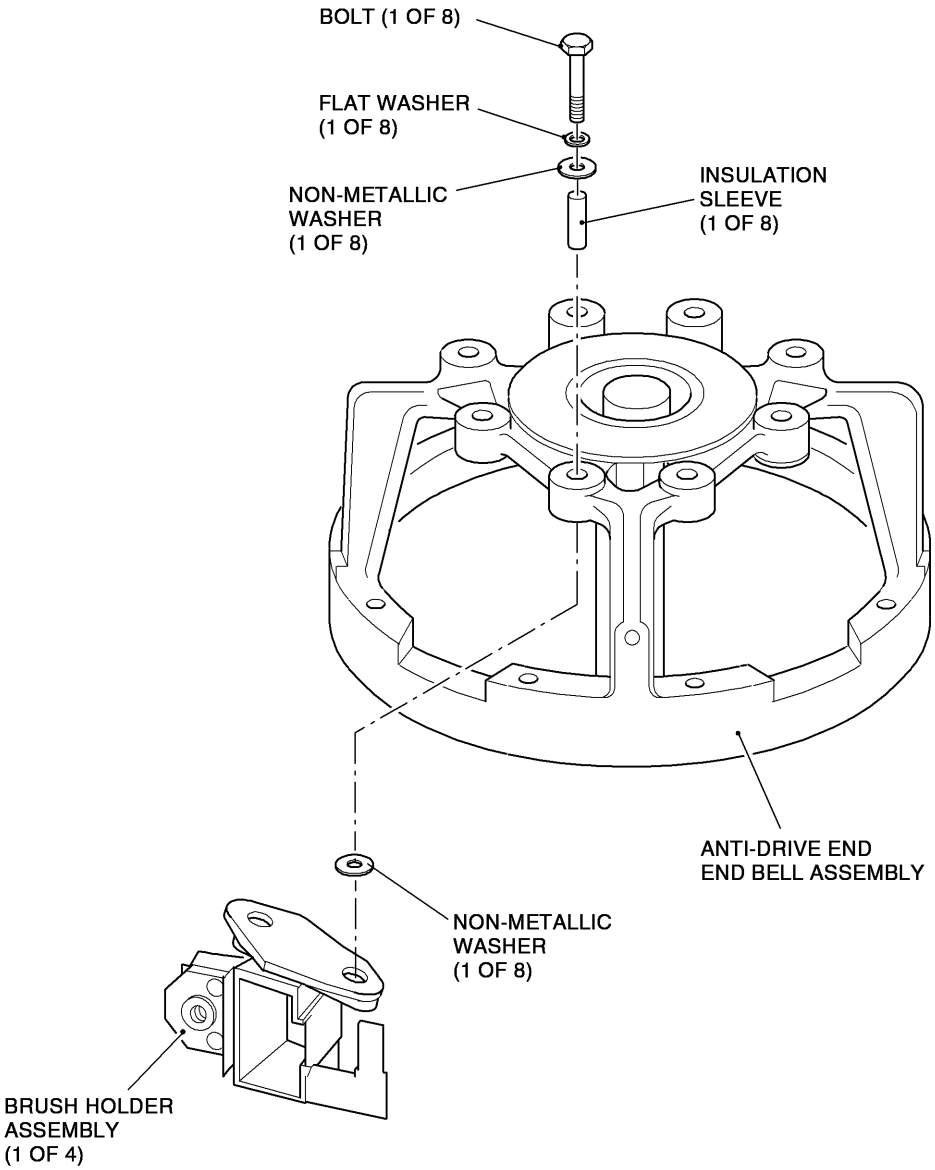

Figure 3007 - Removing Brush Holder Assemblies

(b) Remove brush holder assembly (-420) and two insulation sleeves (440).

(c) Unclip and remove springs (520) from brush holder.

(d) Remove all insulating enamel residue from end bell and brush holder.

M. Disassemble stator and housing assembly (550).

NOTE: Do not disassemble stator and housing assembly beyond removing the terminal block (600).

(1) If removal of terminal block (600) is necessary, proceed as follows.

(a) Remove large terminal (E, B, and C+) stud nuts (580) and washers (590).

(b) Remove small terminal (A and D) stud nuts (560) and washers (570).

(c) Remove two terminal block mounting screws (610), lock washers (620), and washers (630).

(d) Carefully disconnect stator lead wires from the terminal block studs and position out of the way to allow removal of the terminal block.

(e) Remove terminal block.

CLEANING

1. Introduction

This section provides cleaning procedures for the 23032 Series of DC Starter-Generators.

2. Cleaning Materials

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

WARNING: ISOPROPYL ALCOHOL IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

Table 4001 lists materials required to clean the generator.

NOTE: Refer to GSIL 2006-01 for the use of Brulin 815GD-NF.

Material	Description/Specification	Source
Bag, Polyethylene	Size that will easily enclose parts being washed.	Commercially available
Brush	Non-metallic, soft bristle	Commercially available
Cleaning pads/Wiping cloths	Lint-free, soft fabric	Commercially available
Corrosion Preventive	Cold application, water displacing soft film MIL-C-16173, Grade 3	Commercially available
De-ionized Water	For fresh water, Ion Exchange process to a resistivity not less than 750 kΩ/cm @ 77° F (25° C) min., when measured in accordance with ASTM D1125-95, Method A. For rinse water that is to be reused, check that the resistivity does not fall below 500 kΩ/cm @ 77° F (25° C) min., measured in accordance with ASTM D1125-95, Method A.	Commercially available

Table 4001 - Cleaning Materials

Material	Description/Specification	Source
Desiccant	MIL-D-3464E Type II, Kraft bag, 4 unit bag size Englehard Corporation Desiccate 25 or equivalent	Commercially available
Detergent Refer to the material technical data sheet for recommended dilution and application temperature.	Formula 815 GD or 815 GD-NF Applications: (1) Hot tanks - aluminum safe (2) Ultrasonic cleaning Formula 1990 GD Application: (1) Spray wash cleaning	The Brulin Corporation 2920 Dr Andrew J. Brown Ave. Indianapolis IN 46205-4066 www.brulin.com (V94058)
Isopropyl alcohol	TT-I-735, Grade A See the **WARNING** before using this material. Flash point: 53° F (12° C), FLAMMABLE. Refer to the material safety data (MSD) sheet for the material for additional safety information.	Commercially available
Cleaning solvent	MIL-PRF-680 Type I - Stoddard Solvent Type II - 140° F Solvent	Commercially available

Table 4001 - Cleaning Materials (Continued)

3. Cleaning Procedures

Before performing the CHECK, REPAIR, ASSEMBLY, TESTING AND FAULT ISOLATION and final inspection procedures, components of the generator must be cleaned, rinsed, and dried. All signs of moisture, oil, and other contamination must be removed from the internal structure of the generator to make sure all parts and circuits function correctly. Clean starter-generator according to the following procedures.

WARNING: **COMPRESSED AIR USED FOR CLEANING MUST BE FREE OF OIL AND WATER. WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, DO NOT EXCEED 29 PSIG (200 KPA). WEAR GOGGLES OR A FACE SHIELD TO PROTECT EYES. DO NOT AIM COMPRESSED AIR AGAINST SKIN OR BODILY OPENINGS. CARELESS USE OF COMPRESSED AIR CAN RESULT IN SERIOUS INJURY OR DEATH.**

CAUTION: MAKE SURE THAT COMPRESSED AIR USED TO CLEAN/DRY THE COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

A. Blow out dirt particles.

(1) Put air inlet, metal dampener components, drive shaft, armature assembly, drive end and anti-drive end bearing supports, and stator and housing assembly into a ventilated air spray booth.

(2) Blow away all evidence of dirt with clean, dry, compressed air.

B. Clean the parts and assemblies.

WARNING: **DETERGENT CAN BE DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.**

CAUTION: DO NOT SOAK ALUMINUM OR IVD COATED PARTS FOR MORE THAN 30 MINUTES. A CHEMICAL REACTION MAY RESULT THAT WILL LEAVE THE PART IN AN UNSERVICEABLE CONDITION.

(1) Wash parts using one or more of the approved cleaning procedures outlined in Table 4002.

NOTE: Remove the brushes before cleaning.

Procedure	Instruction
Spray	**CAUTION:** MAKE SURE TO LIMIT PRESSURE USED TO CLEAN PARTS. HIGH PRESSURE MAY REMOVE OR DAMAGE SURFACE COATINGS, CONNECTIONS, AND INSULATION.
	(1) Put parts into a high pressure spray wash booth.
	(2) Spray parts with a solution of Brulin 1990 GD detergent and water. Refer to the material technical data sheet for recommended dilution of water and detergent and solution temperature.

Table 4002 - Cleaning Procedures

Procedure	Instruction
Ultrasonic	**CAUTION:** THE ULTRASONIC CLEANER CAN CAUSE DAMAGE IF YOU OPERATE WITH INCORRECT SOLUTION, OR HIGHER THAN THE RECOMMENDED CLEANING TIME AND TEMPERATURES
	(1) Put parts into ultrasonic cleaning tank using detergent Formula 815 GD or 815 GD-NF and de-ionized water.
	(2) Allow parts to soak for 15 to 20 minutes maximum. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(3) Remove all evidence of dirt with a soft bristle brush or cleaning rag.
Agitation	(1) Put all parts in an agitation tank and clean using detergent Brulin 1990 GD and de-ionized water. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(2) Agitate until all evidence of dirt can be removed from the parts with a soft bristle brush or cleaning rag.

Table 4002 - Cleaning Procedures (Continued)

(2) Rinse parts.

NOTE: Use minimal pressure to rinse parts.

(a) Put parts into a pressure spray wash booth with de-ionized water.

(b) Use soft bristle brush to clean foreign material from slots between commutator bars.

(c) Flush parts using hot water or steam.

(3) Repeat applicable cleaning procedure as necessary until parts are clean and free of dirt.

(4) Dry the parts.

WARNING: ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA.

(a) Check each part for dirt by wiping with isopropyl alcohol on a clean, lint-free cloth.

WARNING: WEAR INSULATED GLOVES AND OBSERVE ALL SAFETY PRECAUTIONS WHEN HANDLING HEATED PARTS TO AVOID PERSONAL INJURY.

(b) Put cleaned parts into an oven at a temperature of 200 to 250° F (93,3 to 121° C) for 2 to 3 hours.

(c) Remove any remaining moisture from parts with a dry, lint-free cloth.

4. Corrosion Preventive

NOTE: If the drive shaft is not expected to be re-installed into a starter-generator immediately after cleaning, apply a corrosion preventive compound to its black oxide coating (identified by a very dark finish).

WARNING: THE CORROSION PREVENTIVE COMPOUND IS FLAMMABLE AND TOXIC, EXTENDED EXPOSURE CAN CAUSE SKIN IRRITATION, DIZZINESS, AND HEADACHE. WHEN EXTENDED EXPOSURE IS NECESSARY, USE RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING.

(1) Apply a layer of MIL-C-16173, grade 3, corrosion preventive compound to the drive shaft.

NOTE: The drive shaft must be completely dry before you apply the corrosion preventive compound.

(2) Let the coating air dry for four hours. The coating will remain soft after drying.

5. Cleaning After Liquid Penetrant Inspection

A. Description

This specifies the procedure for cleaning part(s) after liquid penetrant inspection. Cleaning is necessary to remove residual penetrant or developer that could cause interference in processing or service requirements. Rinse parts fully with water and fully dry to make sure there is no interference in processing or service requirements.

B. Procedure

(1) Rinse the part(s) immediately after liquid penetrant inspection:

(a) The parts must be fully rinsed using water by manual or automated spray to remove the liquid penetrant.

1 Fully rinse the part(s) and aggressively agitate the part while it is immersed.

2 Pour the rinse water out from the part(s). Hold the part(s) vertical, open end down, for approximately one minute to drain.

(b) The part(s) surfaces must be visually examined under a black light after rinsing to make sure all the liquid penetrant has been removed.

1 Part(s) which show remaining liquid penetrant after rinsing must be fully cleaned and examined again.

(2) Drying of part(s) after rinsing:

CAUTION: REMAINING WATER USED FROM THE RINSING PROCEDURE MUST BE REMOVED. FAILURE TO OBEY DRYING INSTRUCTIONS CAN RESULT IN CORROSION OF THE MATERIAL.

(a) Remove the rinse water from the part(s) with a dry lint-free cloth.

WARNING: **WHEN YOU USE COMPRESSED AIR. ADJUST THE PRESSURE TO 29 PSI (200 KPA) MAXIMUM. PUT ON EYE PROTECTION TO PREVENT INJURY.**

CAUTION: MAKE SURE THAT COMPRESSED AIR FOR USE TO CLEAN/DRY THE COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(b) Use compressed air to remove rinse water.

WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HOT MATERIALS CAN CAUSE SEVERE BURNS TO SKIN. WEAR THERMAL PROTECTIVE CLOTHING WHEN HANDLING HEATED PARTS.**

(c) Immediately put the washed and rinsed part(s) in an oven at a temperature of 200 to 250° F (93,3 to 121° C) for 2 to 3 hours.

1 The part(s) is to be positioned horizontally on a rack or on a block that will hold it in position.

(d) After the part(s) is fully dried and has cooled.

1 Check for indications of possible corrosion caused by the liquid penetrant.

a Reject the part(s) if corrosion is found.

2 If no corrosion is found, put the part(s) in a polyethylene bag with a bag of desiccant and seal it with tape, twist tie or rubber band.

3 The part(s) must be kept in a bag with desiccant until just before it is assembled on the starter-generator.

CHECK

1. Introduction

This section provides initial and detailed component inspection procedures for generators returning from service for scheduled and unscheduled maintenance. Complete an initial inspection of the starter-generator before beginning any testing or disassembly. The results of this inspection will determine if a starter-generator is in satisfactory condition for a verification test or if it will need further disassembly, inspection, and/or replacement of parts.

This section provides figures and tables with information that is needed to perform a satisfactory inspection of the starter-generator components. During an overhaul of the starter-generator, examine all primary components to find out if they are serviceable.

A part must be rejected if wear or damage is outside acceptance limits or if part is not serviceable.

2. Inspection Tools and Materials

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

The tools and materials in Table 5001 are needed to examine the starter-generator.

NOTE: Equivalent substitutes may be used for the tools and listed in Table 5001.

Tool/Material Description	Reference
Ammeter	Commercially available
Dynamic Balancer (Safran Power Standard Practice Document (SPD) 1001)	Commercially available
Growler	Commercially available
High Potential Tester, 250 VAC rms, 50/60 Hz	Commercially available
Isopropyl Alcohol, TT-I-735, Grade A	Commercially available
LCR Meter	Commercially available
Lint-Free Cloth	Commercially available
Magnifier, 7x to 10x	Commercially available
Ohmmeter	Commercially available
Pull Scale	Commercially available
Soft Bristle Brush	Commercially available
Surface Plate	Commercially available

Table 5001 - Inspection Tools and Materials

Tool/Material Description	Reference
V Blocks	Commercially available
Dampener Plate Gauge Tool, P/N 19-601076	Figure 9014

Table 5001 - Inspection Tools and Materials (Continued)

A. Use of Growler

A growler is required to check for shorted armature windings. When an alternating current is passed through a growler, the current sets up a magnetic flux in the windings of the armature. As the flux passes through the windings, a potential is induced causing current to flow if the winding is short-circuited. The current flow is then detected by an iron feeler, such as a hacksaw blade.

The most common way of using a growler is the ‘feeler method’ in which the growler spans a slot containing a winding. The feeler of iron is held along the slot containing the other side of the same winding. If the winding is shorted, the feeler will pull towards the lamination stack and vibrate. The feeler can also be used on the same side of the winding that is spanned by the growler.

3. General Information

Check acceptance limits for individual components are found in the FITS AND CLEARANCES section. Parts that do not meet acceptance limits are to be discarded. Use the following procedures for all inspections.

A. Inspect generator and components for:

- signs of corrosion
- chipped enamel
- nicks, cracks, dents, scratches
- loose or defective attaching parts
- distortion
- discoloration due to heat or friction
- crossed or stripped threads
- rounded, stripped, or uneven wear of drive shaft spline
- loose or damaged air inlet or fan assembly
- bent or distorted springs
- gouging, scoring or glazing mating surfaces

B. Inspect electrical connections and wiring for:

- loose or defective attaching parts
- chafing, cracking, or burning of wire insulation
- corroded contacts or terminals
- signs of electrical arcing
- damage caused by too much heat

4. Initial Inspection

NOTE: If damage is found during inspection, stop inspection immediately and begin further disassembly of the generator using instructions in the DISASSEMBLY section.

A. Visually inspect the starter-generator in a brightly-lit work area.

(1) If shipping or handling damage is evident, stop inspection immediately and notify supervisor.

(2) If operational damage is found, record which components need to be repaired or replaced and continue the inspection.

B. Clean exterior of starter-generator.

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(1) Clean surfaces of generator using a lint-free cleaning cloth moistened with isopropyl alcohol.

(2) If needed, loosen any dust particles or grease with a soft bristle brush.

C. Inspect starter-generator per Paragraph 3.A. **and** Paragraph 3.B.

If drive shaft spline is visibly damaged, discontinue inspection and proceed to DISASSEMBLY.

D. Turn drive shaft counterclockwise facing the drive end.

(1) The armature assembly should rotate with no scraping or bearing noise.

(2) If armature assembly will not turn, or if indications of internal damage can be heard, discontinue inspection and proceed to DISASSEMBLY.

E. Examine the seating between stator and housing assembly and end bells.

(1) Make sure that end bells are fully seated with stator and housing assembly.

(2) Make sure that all attaching hardware is in place and tight.

5. Non-Destructive Test (NDT) Inspections

A. Unless otherwise specified, do magnetic particle inspections IAW ASTM-E1444. Unless otherwise specified, acceptance criteria must be IAW-MIL-STD-1907 Table 1, Grade A.

B. Unless otherwise specified, do liquid penetrant inspections IAW ASTM-E-1417 type 1 Method A or B, sensitivity 2 or higher. Unless otherwise specified, acceptance criteria must be IAW MIL-STD-1907 Table II, Grade C.

6. Replacing Service Parts and Common Hardware

A. Overhaul

During overhaul, replace bearings, brushes and o-rings. Parts that have been removed during disassembly, such as, insulating parts, retaining rings, screws, self-locking nuts and lock washers, must be discarded regardless of their condition. The screws that attach the brush leads to the brush holder do not need to be replaced unless damaged.

B. Service Repair

During repair, inspection or servicing, replace all exposed hardware and flat washers that are damaged, deformed, corroded, or have other apparent defects. Always replace bearings, retaining rings, lock washers and self-locking nuts regardless of their condition if removed during disassembly.

7. Inspection of Generator Parts and Assemblies

A. Overhaul Inspection

At overhaul, examine all primary components of the starter-generator.

B. Repair Inspection

For repair, examine only those components that have been disassembled for repair. Do not disassemble any component for inspection unless given instructions to do so in this section or in the TESTING AND FAULT ISOLATION section.

C. The following terms are referenced in this section

- DISCARD
  If damage to the part is found or the part is outside of acceptance limits in the FITS AND CLEARANCES section, the part must be removed and replaced with a new one.

- REPAIR
  If damage to the part is found or the part is outside of acceptance limits in the FITS AND CLEARANCES section, the part can be repaired by a procedure found in the REPAIR section.

- DISASSEMBLE
  If damage to the part is found or part of the assembly is outside of acceptance limits in the FITS AND CLEARANCES section, disassemble part from assembly and repair or replace damaged part(s).

- REPLACE
  If damage that causes a part to be outside of acceptance limits in the FITS AND CLEARANCES section or there is no repair procedure for that part, replace part. Retain the following parts to submit for remanufacture: armature assembly and stator and housing assembly.

D. Dimensions and points

Letters (i.e., A,B,C,D, etc.) used in an illustration in this section indicate dimensions or points.

E. Surfaces

Numbers (i.e., 1,2,3,4, etc.) used in an illustration indicate surfaces.

8. Inspection of Parts and Assemblies

The following procedures are the basic instructions for examining parts and assemblies of the starter-generator. Perform visual inspections under high-intensity lighting and 7 to 10 power magnification. Refer to FITS AND CLEARANCES for applicable component wear tolerances.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers found in Figure 10001 in the ILLUSTRATED PARTS LIST.

Qualify individual parts and subassemblies according to the following procedures:

- Repair or replace defective components as instructed.
- Inspect only those components that are products of disassembly for repair.
- Do not perform disassembly for inspection, unless further disassembly is indicated through testing, troubleshooting, and fault isolation.

A. Identification Plate (10) and Information Plate (40)

NOTE: Identification plates with superficial nicks, dents and scratches that do not interfere with the legibility of the identification plate, can be reused providing they are sealed with acrylic coating.

(1) Make sure that drive screws (20) and (50) are in place and tight. Remove and DISCARD loose drive screws.

(2) Visually examine the plate for cracks, dents, nicks, and scratches. DISCARD the damaged plate.

(3) Make sure that all information on identification plate is readable. DISCARD the unreadable plate.

B. Fan Cover Assembly (70)

(1) Visually examine for dents or broken welds. DISCARD if damaged.

NOTE: On model 23032-062, the internal surfaces of the fan cover are lined with PTFE coated fiberglass tape.

(2) Visually examine the PTFE coated fiberglass tape for damage and satisfactory adhesion. REPAIR the fan cover assembly (70) if the tape is damaged or unsatisfactory.

C. Brushes (100) and Brush Holders (530) and Springs (520)

(1) Visually examine brush holders for cracks, warpage, and broken springs (520).

(a) REPLACE broken springs and damaged brush holders.

(2) Visually examine brushes for cracks, chips, frayed leads, and loose rivets or shunt connections.

(a) DISCARD brushes if damaged.

(3) Visually examine wear indicator for remaining allowable wear.

(a) REPLACE brushes if remaining allowable wear will be exceeded before the next overhaul. Seat new brushes in accordance with instructions in SPD 1006.

(4) Visually examine the brush springs for evidence of sand blasting.

(a) DISCARD brush springs if evidence of sand blasting is found.

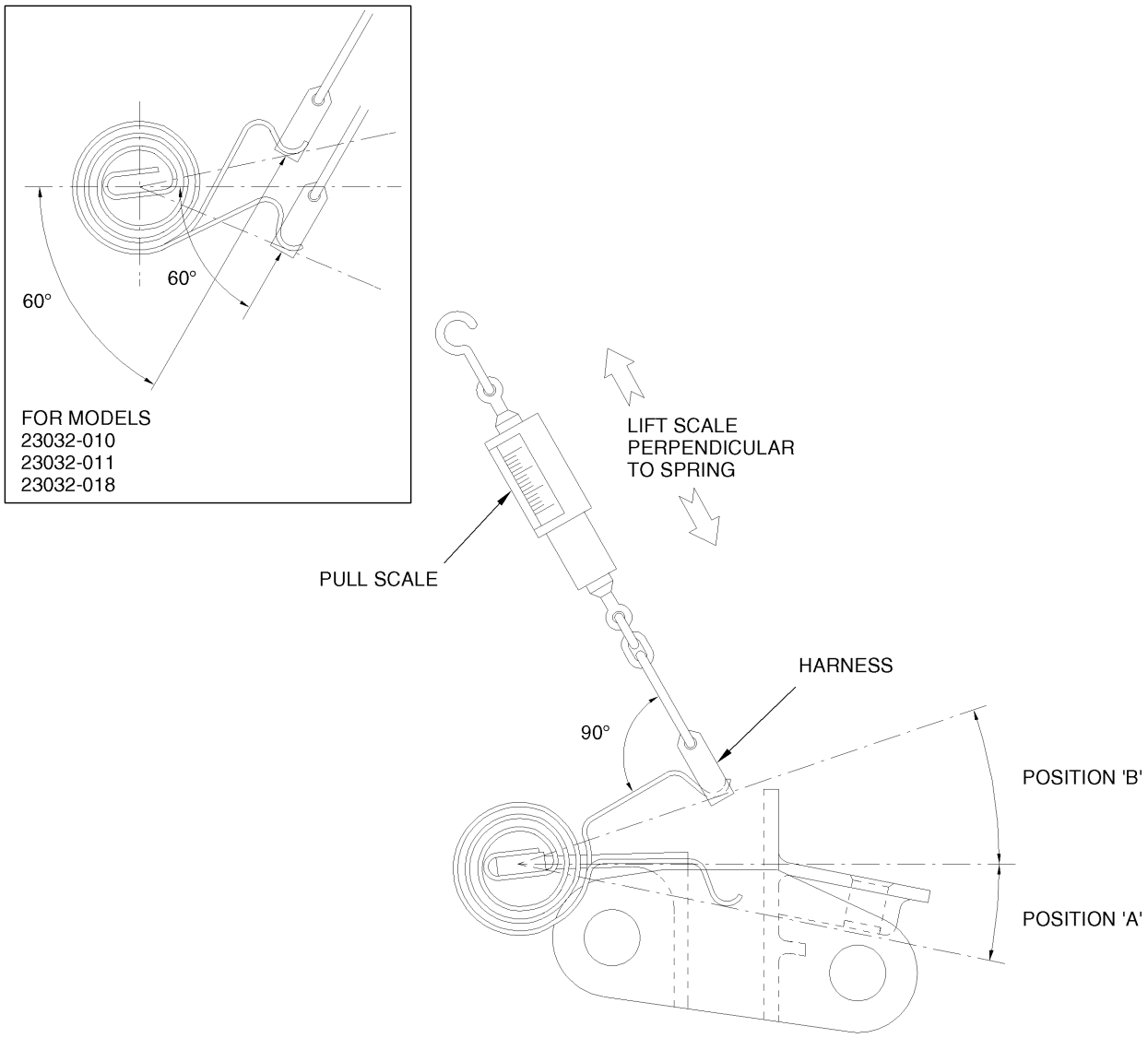
(5) Measure brush spring (520) force using a pull scale with harness. See Figure 5001.

NOTE: When measuring brush spring force, readings can vary widely depending on where measuring device touches spring. Measurements must be taken from curved tip of spring at point where spring touches brush.

(a) Take six measurements.

(b) Calculate an average from the measurements.

(c) Discard brush spring if not within limits of FITS AND CLEARANCES.



MODEL 23032-	POSITION A (MIN)		POSITION B (MAX)	
	ANGLE	FORCE	ANGLE	FORCE
010, 011, 018	23°	1.95 lb (0,88 kg)	12°	2.75 lb (1,25 kg)
025, 026, 027, 028, 042, 043, 044, 048, 049	20°	2.40 lb (1,01 kg)	12°	3.30 lb (1,50 kg)
045, 046, 047, 051, 052, 054, 062	12°	1.75 lb (0,79 kg)	20°	2.50 lb (1,13 kg)

Figure 5001 - Determine Spring Force

D. Fan Assembly (200)

(1) One and two part fans.

(a) Visually examine for chips, cracks, loose blades, or a bent or broken condition.

NOTE: Pay particular attention to the blade edges and surfaces and shaft mating surface.

1 DISCARD the part if cracks, scoring-gouging-glazing on mating surfaces, or major damage exists.

2 REPAIR the fan if minor surface damage is found.

(b) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

1 If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(c) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW Paragraph 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

1 REPLACE if damage is found.

(2) Two part fans only.

(a) Visually examine that forward and back edges of blade(s) do not protrude beyond locating shoulder of fan hub more than limits in FITS AND CLEARANCES.

1 DISCARD fan if protrusion is excessive.

2 REPLACE the two part fan if the hub is loose or there is a bent fin.

E. Drive Shaft (120) and Dampener Hub (160)

(1) Visually examine all surfaces for cracks.

(a) DISASSEMBLE drive shaft and dampener hub if damage is found.

(b) DISCARD damaged part(s).

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR drive shaft and dampener hub if minor damage is found.

(3) Visually examine screw threads for crossed or stripped threads.

(a) REPAIR threads if two or less threads are damaged.

(b) DISASSEMBLE drive shaft and dampener hub if two or more threads are damaged and DISCARD drive shaft.

(4) Visually examine mating spline, drive spline and dampener hub for rounding, stripping, or uneven wear (Figure 5002).

(a) DISASSEMBLE drive shaft and dampener hub if damage is found.

(b) DISCARD damaged part(s).

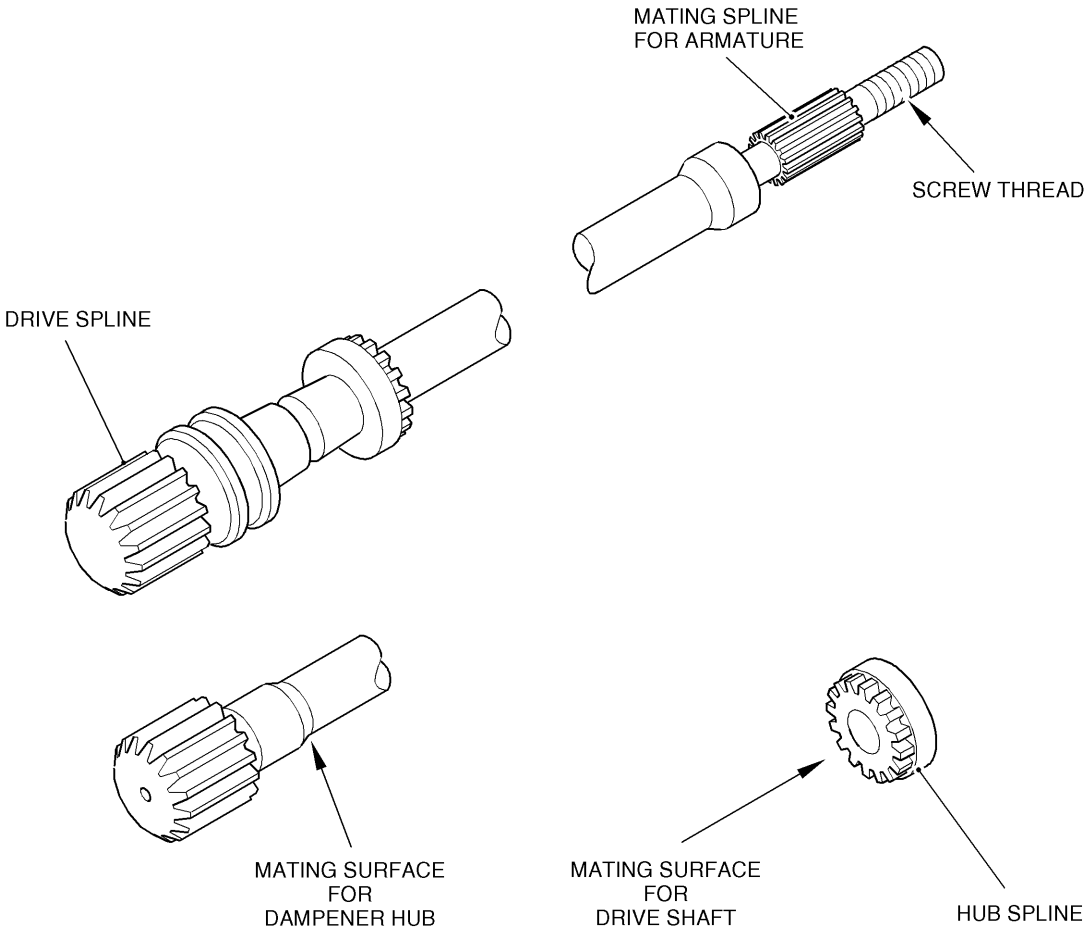


Figure 5002 - Drive Shaft and Dampener Hub

(5) Measure the drive end and anti-drive end spline diameters over two gauge pins.

(a) DISASSEMBLE drive shaft and dampener hub if diameter is not within limits in the FITS AND CLEARANCES section.

(b) DISCARD drive shaft.

(6) Perform a magnetic particle inspection IAW procedures found in Paragraph 5.A.

(a) DISCARD drive shaft and dampener hub if damage is found.

NOTE: Examine drive shaft and dampener hub mating surfaces only if dampener hub was removed from drive shaft.

(7) Visually examine mating surfaces for gouging, scoring, or glazing.

(a) DISCARD drive shaft and dampener hub if damage is found.

F. Friction Ring (180)

WARNING: DO NOT CUT, RIP, OR SAND ASBESTOS-CONTAINING MATERIALS. LEAVE UNDAMAGED MATERIALS ALONE AND, TO THE EXTENT POSSIBLE, PREVENT THEM FROM BEING DAMAGED, DISTURBED, OR TOUCHED. DISCARD MATERIAL BY FIRST CHECKING WITH LOCAL HEALTH, ENVIRONMENTAL, OR OTHER APPROPRIATE OFFICIALS TO FIND OUT ABOUT PROPER HANDLING AND DISPOSAL PROCEDURES.

(1) If friction ring is P/N 02-5600-05, it must be discarded because it contains asbestos. Reference SIL 02-5600.

(2) Visually examine all surfaces for cracks.

(a) DISCARD friction ring if damage is found.

(3) Measure friction ring thickness (Figure 5003).

DISCARD friction ring if the thickness is not within limits in the FITS AND CLEARANCES section.

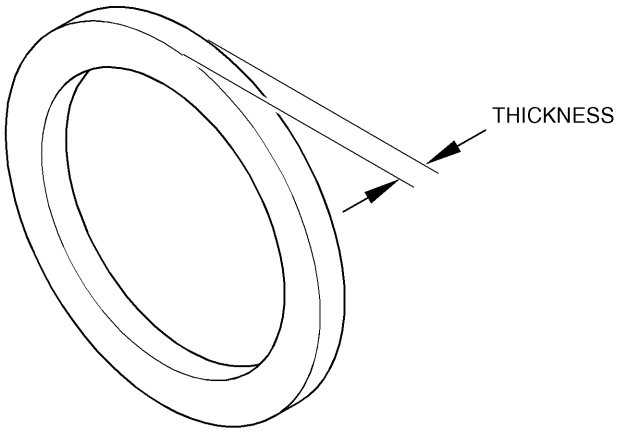


Figure 5003 - Friction Ring Thickness Check

G. Dampener Plate (170)

(1) See Figure 5004. Visually examine all surfaces for cracks or warpage.

(a) DISCARD dampener plate if damage is found.

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR dampener plate if minor damage is found.

(3) Visually examine mating surfaces for gouging, scoring, or glazing.

(a) REPAIR dampener plate if minor damage is found.

(4) Visually examine spline teeth for rounding, stripping, or uneven wear.

(a) DISCARD dampener plate if damage is found.

(5) Measure dampener plate thickness.

(a) DISCARD dampener plate if it is not within acceptance limits in the FITS AND CLEARANCES section.

(6) Use the dampener plate gauge (19-601076) to check the splines of the dampener plate (170), or measure the distance between pins of the spline teeth.

(a) The dampener plate (170) is acceptable if the plate has a tight fit on the dampener plate gauge or does not fit.

(b) The dampener plate must be discarded if the plate fits easily on the dampener plate gauge or is loose.

(c) If measuring the distance between spline teeth, DISCARD if distance is above the acceptance limit in the FITS AND CLEARANCES section.

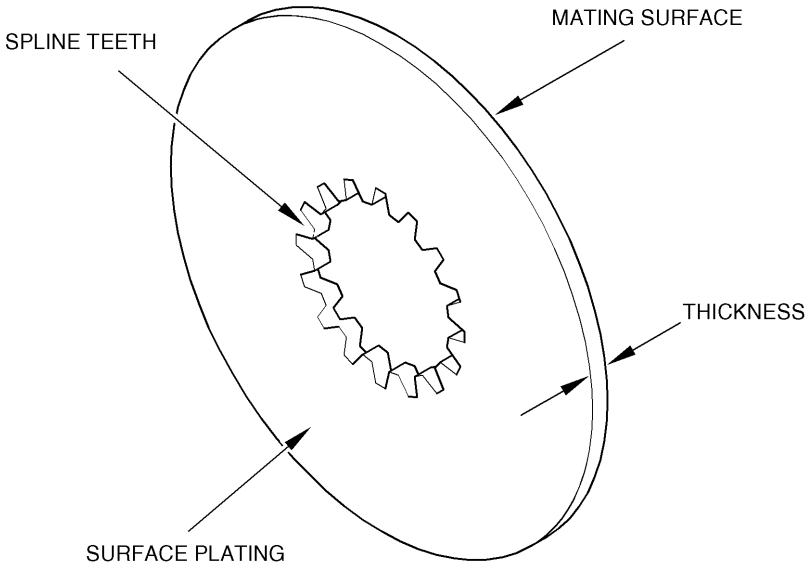


Figure 5004 - Dampener Plate Checks

(7) Perform a magnetic particle inspection IAW procedures found in Paragraph 5.A.

(a) DISCARD dampener plate if damage is found.

H. Dampener Backplate (190)

(1) See Figure 5005. Visually examine all surfaces for cracks.

(a) DISCARD dampener backplate if damage is found.

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR dampener backplate if minor damage is found.

(3) Visually examine the mating surfaces for gouging, scoring, or glazing.

(a) DISCARD dampener backplate if damage is found.

(4) Perform a magnetic particle inspection IAW procedures found in Paragraph 5.A.

(a) DISCARD dampener backplate if damage is found.

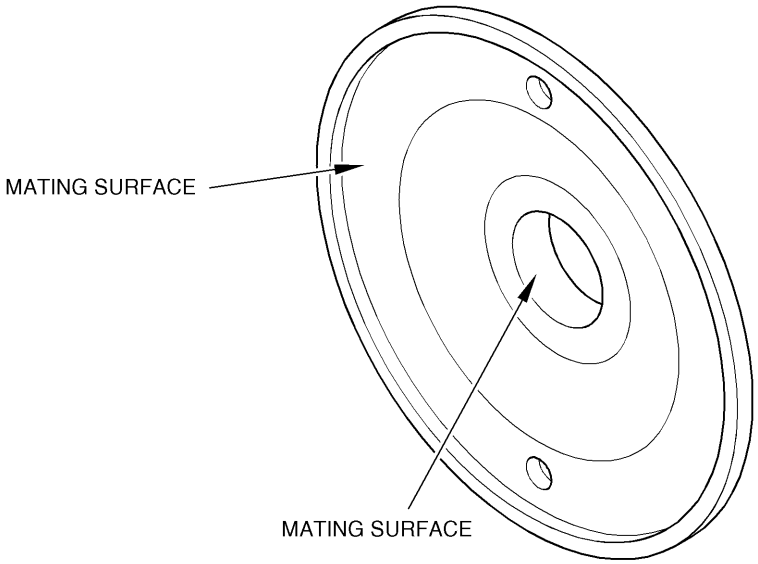


Figure 5005 - Dampener Backplate Checks

I. Drive End End Bell or Drive End Bearing Support Assembly (210).

(1) Visually examine for cracks or warpage.

(a) DISCARD if cracked or warped.

(b) REPAIR if minor dents, scratches and nicks or gouging, scoring or glazing on the mating surfaces are found.

(2) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(3) If the visual inspection under 10X magnification finds indications which can be cracks, perform a liquid penetrant inspection IAW Paragraph 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

(4) Visually examine the following end bell mating surfaces for gouging, scoring, glazing, and fretting.

- Bearing liner
- Mating with stator and housing assembly
- Mating with end bell drive end pad.

(a) REPAIR end bell if damage is found.

(b) DISCARD end bell if repair is not possible.

(5) Measure bearing liner diameter ‘A’. See Figure 5006.

(a) REPAIR the bearing liner if the measurements are not within the limits of the FITS AND CLEARANCES section.

(6) If using an end bell with a screen (270), examine screen for damage.

(a) REPLACE screen if damage is excessive.

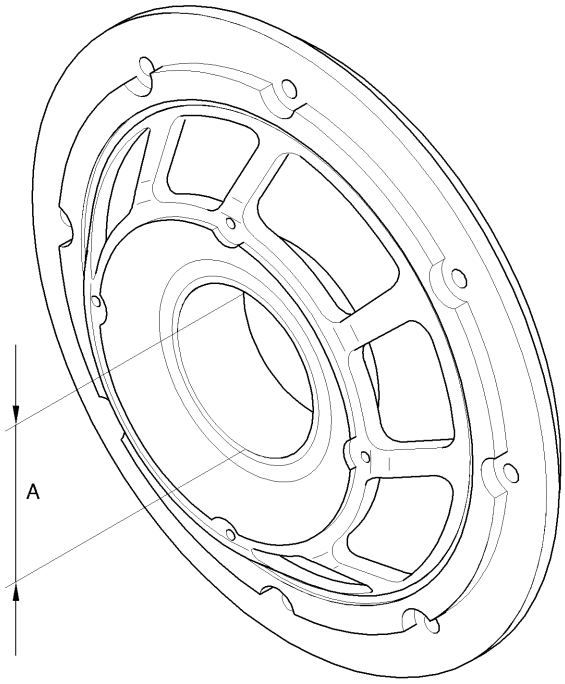


Figure 5006 - Drive End End Bell

J. Baffle Disc (310)

(1) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR baffle disc if minor damage is found.

(2) Visually examine mating surfaces for wear, gouging, scoring, or glazing.

(a) DISCARD baffle disc if damage is found.

K. Armature (330)

CAUTION: INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) IS NOT APPROVED ON THE ARMATURE WINDINGS. THE ARMATURE MUST BE REPLACED IF YOU FIND INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) ON THE ARMATURE WINDINGS.

(1) Visually inspect for worn, pitted or burned commutator bars.

(a) REPAIR commutator in accordance with commutator refinishing instructions in REPAIR section, if necessary.

(2) Visually inspect commutator for bar to bar concentricity and concentricity to the armature shaft.

(a) REPAIR commutator in accordance with commutator refinishing instructions in REPAIR section if concentricity is not within limits in FITS AND CLEARANCES.

(3) Visually inspect for the following indications of damage or overheating:

- varnish coating of exposed windings cracked or flaking.
- missing, melted, or deformed insulators.
- missing mica from between commutator bars.

(a) REPLACE armature assembly if indications of damage or overheating are found.

(4) Check winding retainer bands for damage and tightness of fit.

(a) REPLACE armature assembly if damaged or movement of retainer bands can be detected.

(5) Visually inspect bearing journals for galling, spalling, scoring, discoloration, or other indications of bearing spin on shaft.

(a) If indications are found, check surface roughness with fingernail.

(b) REPLACE armature assembly if surface roughness can be felt.

(6) Examine the armature for insulating enamel (Glyptal or equivalent).

(a) REPLACE the armature if insulating enamel (Glyptal or equivalent) is found on the armature windings.

(7) Measure bearing journal diameters, A and C. Refer to Figure 5007.

(a) REPLACE armature assembly if journal diameters are not within limits of FITS AND CLEARANCES.

(8) Measure commutator diameter B, as shown in Figure 5007.

(a) REPLACE armature if minimum commutator diameter B is below limit in FITS AND CLEARANCES section.

(9) Examine internal spline for rounding, stripping, or uneven wear.

(a) Check the drive spline for too much wear by engaging a new drive shaft into the armature internal drive spline. Reject the armature shaft if too much play is found when engaging the drive shaft.

NOTE: An armature spline with too much wear will not engage tightly with a new drive shaft.

(b) REPLACE armature if damaged.

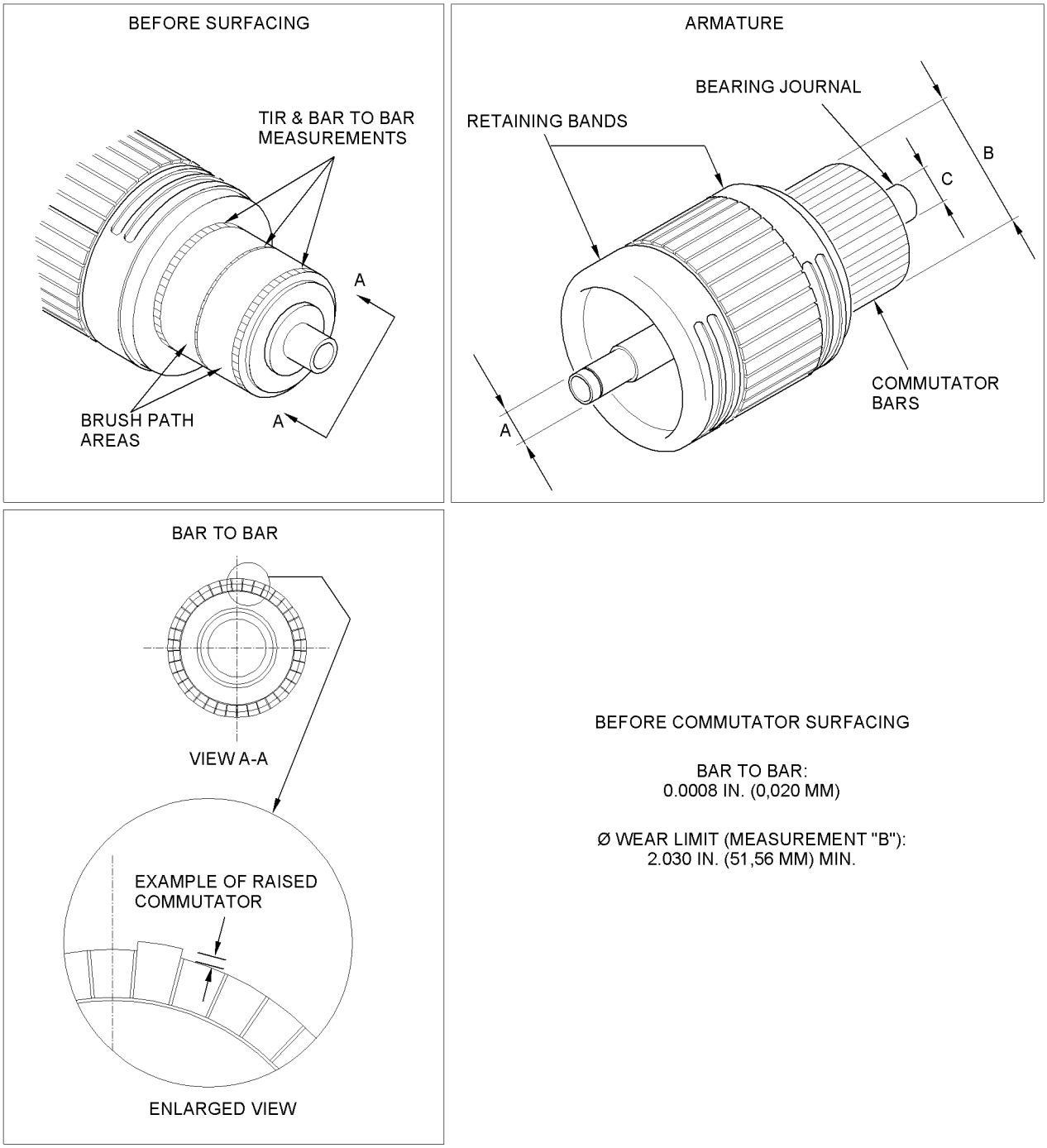


Figure 5007 - Armature Check

(10) Measure commutator undercut.

(a) REPAIR commutator if mica undercut depth (before recut) is below limits in FITS AND CLEARANCES section.

(b) REPLACE armature if damage is not repairable.

(11) After the commutator is refinished, measure commutator bar-to-bar and total indicator reading (TIR) run-out in a full circumference. Support the armature on two V blocks.

(a) Measure commutator bar-to-bar run-out.

Resurface armature if bar-to-bar run-out is more than the limits of the FITS AND CLEARANCES section.

(b) Measure commutator TIR run-out.

Resurface armature if TIR is more than the limits of the FITS and CLEARANCES section.

(12) Check armature assembly balance at two planes using a dynamic balancer. Refer to SPD 1001.

(a) If balance measurements exceed limits in SPD 1001, balance armature assembly per applicable REPAIR instructions.

(13) Conduct a high potential test as follows.

WARNING: **BEFORE YOU OPERATE THE HIGH-VOLTAGE TESTER, MAKE SURE THAT THE POWER SWITCH IS IN THE 'OFF' POSITION. MAKE SURE THAT NO PERSON TOUCHES THE EQUIPMENT OR THE PROBES. THESE PRECAUTIONS PREVENT POSSIBLE DEATH OR INJURY FROM ELECTRIC SHOCK.**

CAUTION: YOU CAN CAUSE SERIOUS DAMAGE TO THE ARMATURE IF YOU DO NOT TURN OFF THE HIGH POTENTIAL TESTER BEFORE YOU CONNECT THE HIGH VOLTAGE ELECTRICAL LEADS.

CAUTION: THE ARMATURE MUST BE FULLY CLEANED BEFORE YOU DO A DIELECTRIC TEST.

(a) Set the power to the OFF position. Connect the positive test lead of the high potential tester to a commutator.

(b) Set the power to the OFF position. Put the negative test lead on the armature shaft.

(c) Set the high potential tester output voltage to 0. Turn the power to the ON position.

CAUTION: INCREASE AND DECREASE TEST VOLTAGES SLOWLY (100 VOLTS PER SECOND, MAXIMUM). IF THE VOLTAGE IS INCREASED AND/OR DECREASED TOO QUICKLY IT CAN CAUSE DAMAGE TO THE ARMATURE.

(d) At a rate that is not more than 100 V/sec., slowly adjust the output voltage to 250 V RMS, commercial frequency for 1 minute. Slowly decrease the voltage back to 0.

(e) Turn high potential tester power to the OFF position.

(f) Remove negative test lead.

(g) Keep the positive test lead connected to the commutator.

(h) Connect the negative lead to the drive end retaining band.

(i) Do the dielectric test again between the retaining band and commutator.

(j) Turn high potential tester power to the OFF position.

(k) Remove negative test lead.

(l) Keep the positive test lead connected to the commutator.

(m) Connect the negative lead to the anti-drive end retaining band.

(n) Do the dielectric test again between retaining band and commutator.

(o) Turn high potential tester power to the OFF position.

(p) Disconnect all test leads.

(q) Acceptance limits:

1 There must not be indication of moist, dirty, weak or defective components. An indication is flash-over (surface discharge), spark-over (air discharge) or breakdown (puncture discharge). The leakage current must not be more than 2 mA.

2 If the armature does not pass the acceptance limits, clean the armature and do the test again.

3 If the armature does not pass the acceptance limits of the dielectric test after cleaning, replace the armature.

L. Stator and Housing Assembly (550)

CAUTION: INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) IS NOT APPROVED ON THE STATOR WINDINGS. THE STATOR MUST BE REPLACED IF YOU FIND INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) ON THE STATOR WINDINGS.

(1) Visually inspect exposed housing surfaces for cracks, chips, and dents.

(a) REPLACE assembly if cracks, chips, or dents cause loss or permanent deformation of base material.

(2) Visually inspect for the following indications of overheating:

- varnish coating of exposed windings cracked or flaking.
- missing, melted, or deformed insulators.

(a) REPLACE assembly if indications of overheating are found.

(3) Examine the stator for insulating enamel (Glyptal or equivalent).

(a) REPLACE the stator if insulating enamel (Glyptal or equivalent) is found on the stator windings.

(4) Check for tight fit of pole shoes and damage to windings in housing.

(a) REPLACE assembly if stator parts are loose or windings are damaged.

(5) Check terminal block for cracks, and loose or damaged terminal studs.

(a) REPLACE terminal block if damaged.

(6) Perform a dielectric test.

WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.**

CAUTION: FAILURE TO TURN OFF HIGH POTENTIAL TESTER POWER BEFORE CONNECTING OR DISCONNECTING HIGH VOLTAGE ELECTRICAL LEADS CAN CAUSE SERIOUS DAMAGE TO THE STARTER-GENERATOR.

CAUTION: STATOR AND HOUSING ASSEMBLY MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A HIGH POTENTIAL CHECK.

CAUTION: CAPACITORS IMBEDDED IN RADIO NOISE FILTERS IN THE OPERATIONAL TERMINAL BLOCK WILL BE DAMAGED IF SUBJECTED TO DIELECTRIC TEST. ALWAYS DISCONNECT STATOR LEADS FROM THE GENERATOR TERMINAL BLOCK AND CONNECT LEADS TO A DUMMY TERMINAL BLOCK WHEN CONDUCTING DIELECTRIC TEST.

(a) Disconnect stator leads from stator and housing assembly terminal block and reconnect stator leads to a dummy terminal block.

NOTE: Alternatively, if the original terminal block is used, the grounding lead screw can be removed and the grounding lead must be protected with electrical tape.

(b) With power OFF, connect positive test lead of dielectric tester to terminal A.

(c) With power OFF, connect negative test lead to uncoated surface of housing.

(d) With dielectric tester output voltage at 0, turn power ON.

(e) At a rate not to be more than 100 V/sec., slowly adjust output voltage to 250 V RMS, commercial frequency for one minute. Slowly decrease voltage back to 0.

(f) Turn dielectric tester power to OFF.

(g) Disconnect test leads.

(h) Acceptance limits:

1 Arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current that is more than 2mA is evidence of damp, dirty, weak or defective components and constitutes a failure.

If stator and housing assembly (550) fails dielectric test, clean stator and housing assembly and repeat dielectric test.

2 If stator and housing assembly (550) fails dielectric test after cleaning, replace stator and housing assembly.

(i) Disconnect dummy terminal block and reconnect stator leads to the starter-generator terminal block, or replace the screw that attaches the grounding lead.

NOTE: Make sure to remove any electrical tape that was used on the grounding lead.

(7) Measure the resistance between the E negative lead and A positive terminal with an ohmmeter.

(a) REPLACE the stator and housing assembly if the circuit is open.

NOTE: There must be continuity between the two points.

M. Terminal Block (600)

(1) Using an LCR (inductance, capacitance and resistance) meter, measure the capacitance values.

(a) Measure the capacitance values between terminals B and E at the frequency as shown in the FITS AND CLEARANCES section.

1 DISCARD the part if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

(b) Measure the capacitance values between terminal B and the ground lead at the frequency as shown in the FITS AND CLEARANCES section.

1 DISCARD the part if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

(c) Measure the capacitance values between terminal C and the ground lead at the frequency as shown in the FITS AND CLEARANCES section.

1 DISCARD the part if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

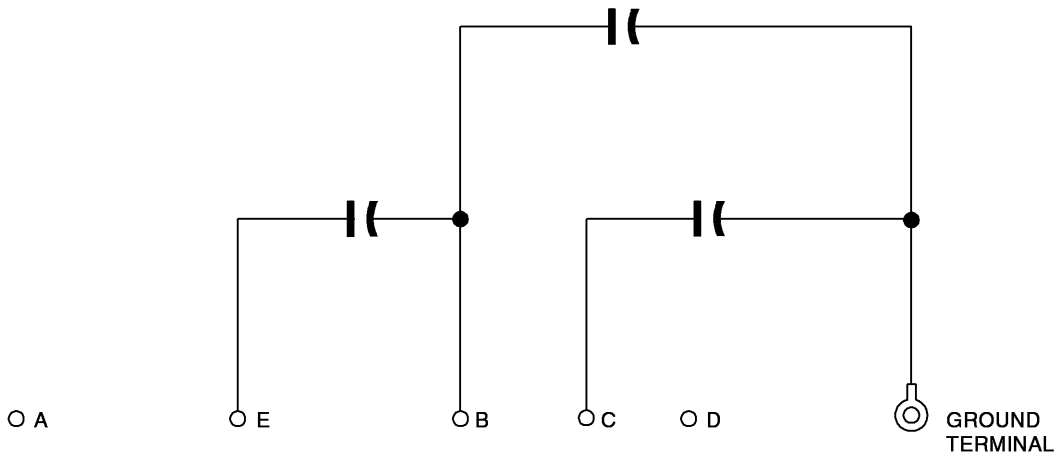


Figure 5008 - Terminal Block

N. Bearing and Brush Support Assembly (-370)

(1) Visually examine all bearing support surfaces for cracks, warpage, dents, nicks, and scratches.

(a) DISASSEMBLE bearing and brush support assembly if damage is excessive.

(b) REPAIR if minor dents, scratches and nicks or gauging, scoring or glazing on the mating surfaces are found.

(c) DISCARD damaged part(s).

(2) If the visual inspection finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(3) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW Paragraph 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

(4) Examine the brush holders (530), including the brush spring supports and center supports for cracks, warping, and discoloration caused by electrical arcing.

(a) Discard the brush holder (530) if damage is found.

(5) Visually examine the following end bell mating surfaces for gouging, scoring, glazing and fretting.

- Bearing liner
- Mating with stator assembly

(a) REPAIR end bell if damage is found.

(b) DISCARD damaged end bell if repair is not possible.

(6) Measure bearing liner diameter ‘A’. See Figure 5009.

(a) REPAIR or REPLACE the bearing and brush support if the bearing liner does not meet the limits in the FITS AND CLEARANCES section.

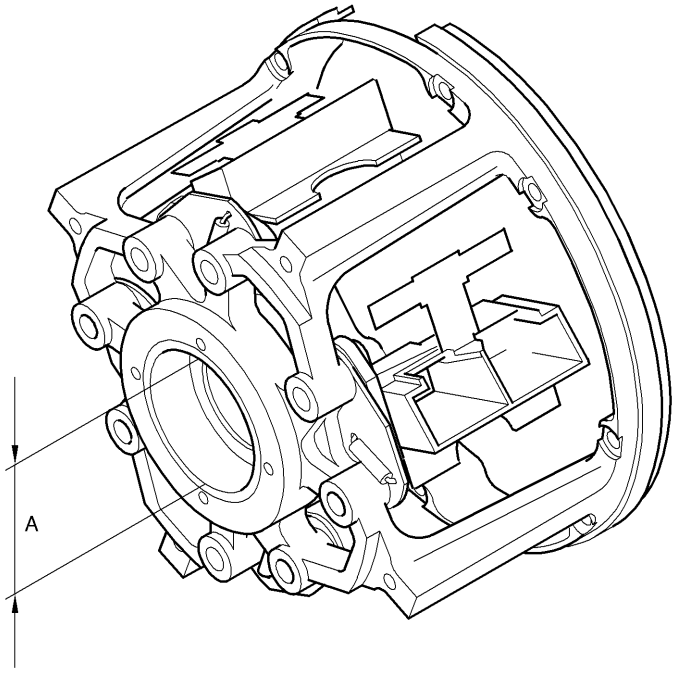


Figure 5009 - Bearing and Brush Support Assembly

(7) Conduct a high potential test between the end bell casting and each brush holder assembly as follows.

WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.**

CAUTION: THIS CAUTION APPLIES TO MODELS 23032-010, 23032-011, 23032-018, 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, AND 23032-062 ONLY. THESE MODELS HAVE FILTER BOARDS ATTACHED TO THE BRUSH HOLDERS THAT CONTAIN CAPACITORS. THE CAPACITORS WILL BE DAMAGED IF SUBJECTED TO DIELECTRIC TEST. TO PREVENT FILTER BOARD DAMAGE, ELECTRICALLY CONNECT ALL BRUSH HOLDERS TOGETHER DURING END BELL DIELECTRIC TEST.

CAUTION: THIS CAUTION APPLIES TO MODELS 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, AND 23032-062 WHICH HAVE FILTER BOARD GROUND LEADS THAT ATTACH TO SCREWS (350) ON THE BEARING RETAINER (340). IF NOT ALREADY DETACHED, THESE LEADS MUST BE DISCONNECTED AND ISOLATED FROM THE END BELL TO PREVENT DAMAGE TO THE FILTER BOARDS DURING DIELECTRIC TEST.

CAUTION: END BELL ASSEMBLY MUST BE THOROUGHLY CLEAN BEFORE PERFORMING A HIGH POTENTIAL CHECK.

(a) Connect hi-pot leads between end bell casting (540) and each brush holder (530).

(b) With dielectric tester output voltage at 0, turn power ON.

(c) At a rate not to be more than 100 V/sec, slowly adjust output voltage to 250 V RMS, commercial frequency for 1 minute or 300 V RMS for 1 second. Slowly decrease voltage back to 0.

(d) Turn dielectric tester power OFF.

(e) Disconnect test leads.

(f) Acceptance limits:

1 Arcing as evidenced by flashover (surface discharge), spark over (air discharge), breakdown (puncture discharge), or leakage current that is more than 2mA is evidence of damp, dirty, weak or defective components and constitutes a failure.

If ADE bearing and brush support assembly (370) fails dielectric test, disassemble and inspect non-metallic washers (470), and insulation sleeves (440). Replace defective parts as necessary. Repeat the dielectric test.

2 If ADE bearing and brush support assembly (370) fails dielectric test again, replace ADE bearing and brush support assembly.

O. Filter Board Assembly (450)

(1) Measure the capacitance value of each capacitor on the filter board assembly (450) at a frequency of 900 to 1100 Hz, 77° F (25° C).

(a) DISCARD the filter board assembly if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

P. Bearing Retainer (340)

(1) Visually inspect bearing retainer for cracks, chips, and dents.

(a) DISCARD retainer if cracks, chips, or dents cause permanent deformation.

(2) Place bearing retainer on surface plate to check for warping.

(a) DISCARD retainer if warpage is indicated.

Q. QAD Kit (650)

NOTE: When the starter-generator has been removed from service, the QAD kit usually stays on the aircraft.

(1) Visually examine the parts for signs of damage and corrosion. DISCARD parts if corrosion is found.

(2) If the visual inspection of the end bell drive end pad finds indications which can be cracks, continue the inspection under 10X magnification.

(a) If visual indications of cracks or other structural defects are observed under 10X magnification, DISCARD the part.

(3) If the visual inspection under 10X magnification finds indications which can be cracks, perform a liquid penetrant inspection IAW Paragraph 5.B.

NOTE: After liquid penetrant inspection, the part(s) must have the liquid penetrant removed to prevent interference with processing or with service requirements. Refer to the CLEANING section.

(a) REPLACE if damage is found.

R. Rim-Clenching Clamp (670) and T-Bolt (-690)

(1) Visually examine the clamp for nicks, cracks, dents and scratches.

(a) DISCARD the part if damage exists.

(2) Examine the T-bolt for damaged threads.

(a) REPAIR the part if two or less threads are damaged.

(b) DISCARD the part if more than two threads are damaged.

9. Terminology

Table 5002 lists the definitions of terms used to describe damage conditions.

Term	Definition	Probable Cause
Corrosion	The chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.	Environmental condition that causes deterioration.
Crack	A break in material	Severe stress from overloading or shock; possible extension of a scratch
Dent	A small, smoothly-rounded depression	A sharp blow or excessive pressure
Fretting/ Corrosion	Surface chemical reaction that results in discoloration, a layer of oxide, or rust	Vibration between mating surfaces
Galling	Transfer of metal from one surface to another	Result of localized lubrication breakdown between sliding surfaces
Glazing	Smoothing and creep of a surface	Result of localized lubrication breakdown between sliding surfaces
Gouging	Removal of surface metal, typified by rough and deep depressions	Protruding objects, incorrectly aligned
Nick	A sharp-bottomed depression that may have rough outer edges	Dropping, banging
Rounding	Removal of surface metal at corners or dulling of edges	Result of abrasion, vibration, or incorrect tolerances
Scoring	Deep scratch following a path of part travel	Result of localized lubrication breakdown between sliding surfaces
Scratch	A very shallow furrow or irregularity, usually longer than wide	Movement of a sharp object across the surface
Short	Evidence of sparking, arcing, or high current	The result when two current carrying conductors are connected by a path of negligible resistance

Table 5002 - Terminology

Term	Definition	Probable Cause
Stripped Thread	Thread of a nut, stud, bolt, or screw damaged by tearing away parts of the thread	Incorrect installation of thread pitch or size
Tear	Parting of material	Excessive tension, caused by an external force
Wear	Slow removal of parent material, wear may not be visible to the naked eye	Result of abrasive substances contacting rolling surfaces and acting as a lapping compound

Table 5002 - Terminology (Continued)

REPAIR

1. Introduction

This section provides authorized repair instructions for the 23032 Series of DC Starter-Generators. Repairs are limited to:

- Repairing damaged surfaces
- Restoring surface coatings of parts and assemblies
- Repairing damaged threads
- Restoring bearing liners and journals
- Repairing and refinishing armature commutator
- Balancing the armature
- Brush seating
- Replacing fan cover insulating tape.

Repair operations not outlined or referenced in this manual are not authorized by Safran Power.

CAUTION: THE USE OF PARTS, MATERIALS, OR PROCESSES NOT AUTHORIZED BY SAFRAN POWER FOR THE MAINTENANCE AND/OR OVERHAUL OF THE STARTER-GENERATOR MAY AFFECT CONTINUED FLIGHT WORTHINESS AND/OR INVALIDATE ITS CERTIFICATION.

In addition to specific repairs authorized by Safran Power in this manual, standard repair procedures for starter-generators are described in the following Safran Power Standard Practice Documents (SPD).

- Selective (Brush Plating), Electrodeposition - Refer to SPD 1000.
- Armature Balancing for DC Starter-Generators - Refer to SPD 1001.
- Surface Repair and Coating - Refer to SPD 1002.
- Plastic Media Blasting - Refer to SPD 1003.
- Brush Holder Alignment Fixtures - Refer to SPD 1004.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Repair Tools

In addition to normal shop tools, the following tools are needed for starter-generator repair.

CAUTION: STEEL WOOL AND ABRASIVES CONTAINING IRON OR IRON OXIDE MUST NOT BE USED AT ANY TIME DURING REPAIR OPERATIONS.

Tool Description	Reference
Commutator Turning Fixture	Figure 9011
Crimp Tool	Commercially available
Dynamic Balancer	Safran Power SPD 1001
End Mill [0.25 inch (6,4 mm) diameter]	Commercially available
India Stone	Commercially available
Switch	Commercially available
Six V Battery of equivalent DC Power Source	Commercially available
Tension Gauge	Commercially available
Thread-Chasers	Commercially available
Triangular Scraper	Commercially available
V-blocks	Commercially available

Table 6001 - Repair Tools

3. Repair Materials

Materials used for repair are listed in Table 6002.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

NOTE: Repair materials are not available from Safran Power. All items can be purchased commercially.

Item	Description/Specification	Source
Alcohol, Isopropyl	TT-I-735, Grade A See **WARNING** before using this material. Flash point: 53° F (12° C), FLAMMABLE. Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information.	Commercially available
Brush, Soft Bristle, non-metallic	-	Commercially available
Chemical Film Solution Alodine 1200 or Pen, Touch-N-Prep	Chemical Film Solution MIL-C-5541, Class 3 or Alodine 1132 Touch-N-Prep Pen IAW MIL-DTL-81706B	Henkel Surface Technology 32100 Stephenson Hwy Madison Heights MI 48071 (V1N6B3)
Enamel, Gloss Black	MIL-PRF-85285	PRC-DeSoto International Inc 6022 Corporate Way Indianapolis IN 46278 (VOLZEO)

Table 6002 - Repair Materials

Item	Description/Specification	Source
Enamel, Red Insulating, Baking	Synthite ER-41	John C. Dolph Company 320 New Road PO Box 267 Monmouth NJ 08852 (V72688)
Oil, Lubricating	MIL-PRF-6085	Commercially available
Pads, Cleaning	Lint-free cotton	Commercially available
Primer, Zinc Chromate	TT-P-1757, Composition G, Color Y	Commercially available
Sandpaper	400/600 grit (non-aluminum oxide only)	Commercially available
Tape, Insulating	P/N SG13-06(R) PTFE coated fiberglass, 0.008 inch (0,2 mm) thick	Philpott Brunswick, OH www.philpottrubber.com (V1T7E9)

Table 6002 - Repair Materials (Continued)

4. Surface Repair

Repair corroded or damaged surfaces of parts that have qualified for repair according to the inspection criteria in the CHECK section.

A. Repair procedure

(1) Remove corrosion, sharp edges, burrs, nicks, or scratches from cast surfaces, machined mating surfaces, and sealing surfaces with india stone or abrasive paper. Remove only sharp edges or burrs that are above surface of part.

(2) Remove minor raised edges, burrs, nicks, or scratches on any polished or load-bearing surface. Remove only material that extends above polished surface. Make sure that dimensional tolerances are within limits.

5. Restoring the Surface Coatings of Parts and Assemblies

A. Removal of surface coatings

Remove the surface coatings of parts and assemblies that have been damaged using plastic blasting equipment and procedures IAW SPD 1003.

NOTE: Follow the quality assurance guidelines listed in SPD 1003 for the use of plastic media blasting equipment.

B. Restoration of surface coatings

Restore surface coatings of parts and assemblies with materials and procedures given in Safran Power SPD 1002.

6. Thread Repair

A. Repair damaged threads as follows:

CAUTION: DO NOT USE A THREAD-CUTTING DIE. UNREPAIRABLE DAMAGE CAN RESULT FROM USING A THREAD-CUTTING DIE.

(1) Repair damaged threads with a thread chaser.

(2) Remove any remaining sharp edges or burrs with an india stone.

WARNING: LUBRICATING OIL IS FLAMMABLE AND CAN BE HARMFUL IF SWALLOWED. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(3) Apply a light coating of lubricating oil to repaired threads to prevent corrosion.

7. Bearing Journal and Liner Restoration

A. Bearing Journals

(1) If the armature shaft bearing journals are worn beyond limits in the FITS AND CLEARANCES section, restoration may be possible by electrodeposition plating in accordance with Safran Power Standard Practice Document (SPD) 1000.

NOTE: If armature shaft is out of concentricity, machine shaft within concentricity before plating.

(2) Maximum allowable thickness of plating shall be 0.01 inch (0,254 mm), or 0.02 inch (0,508 mm) measured across a diameter.

(3) Armature shaft bearing journals may be plated to final dimensions, or overplated then ground to final dimensions listed in the FITS AND CLEARANCES section.

B. Bearing Liner Restoration

(1) If bearing liners are worn beyond acceptance limits, restoration can be possible. Refer to SPD 1000 for repair limitations and procedures for selective electrodeposition nickel plating. Components not in compliance with the dimensions as applicable, must be reworked or replaced.

(2) Stainless steel bearing liners cannot be repaired. Use a magnet to check if the bearing liner is stainless steel. If the bearing liner is stainless steel, the magnet does not attract to the bearing liner.

(3) Sintered metal bearing liners were used for a short time during the 1980's and cannot be repaired per SPD 1000. Determine if the bearing liner is sintered by measuring the outside diameter (OD) of the bearing liner. See Figure 6001.

(a) For anti-drive end end bell bearing liners:

- Sintered bearing liner will have an exposed OD of approximately 1.67 inch (42,4 mm).
- Steel bearing liners will have an exposed OD of approximately 1.746 inch (44,35 mm).

(b) For drive end end bell bearing liners:

- Sintered bearing liner will have an OD of approximately 1.78 inch (45,2 mm) where it projects from the drive end end bell.
- Steel bearing liners will have an exposed OD of approximately 1.725 inch (43,8 mm).

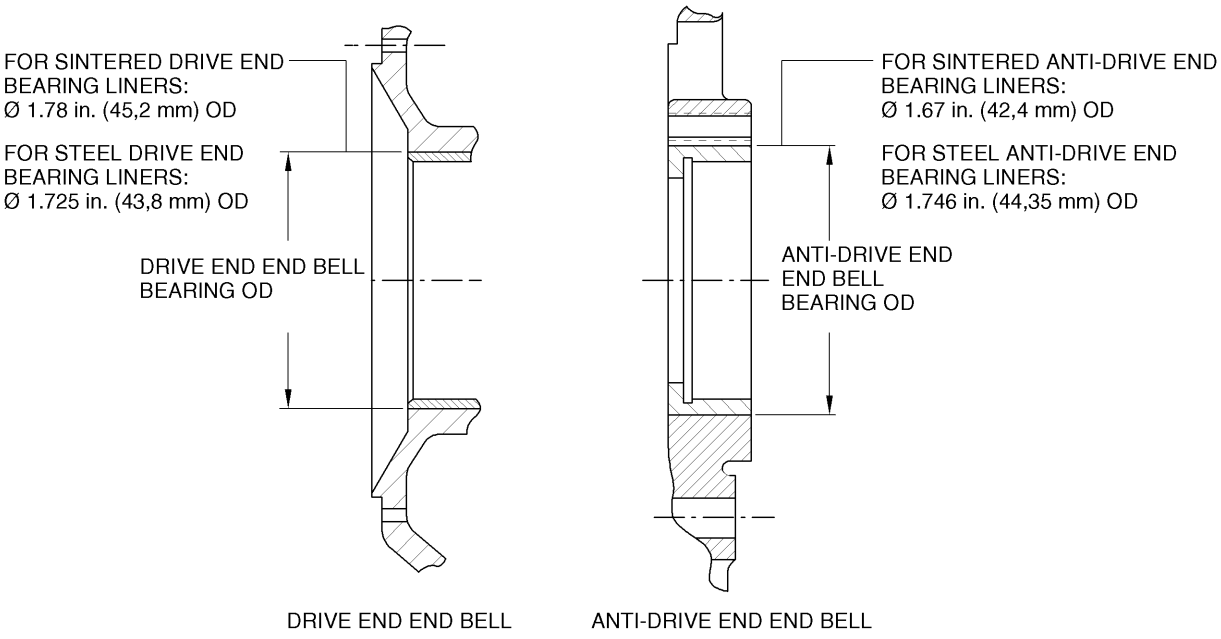


Figure 6001 - Measuring Bearing Liner Outside Diameter (OD)

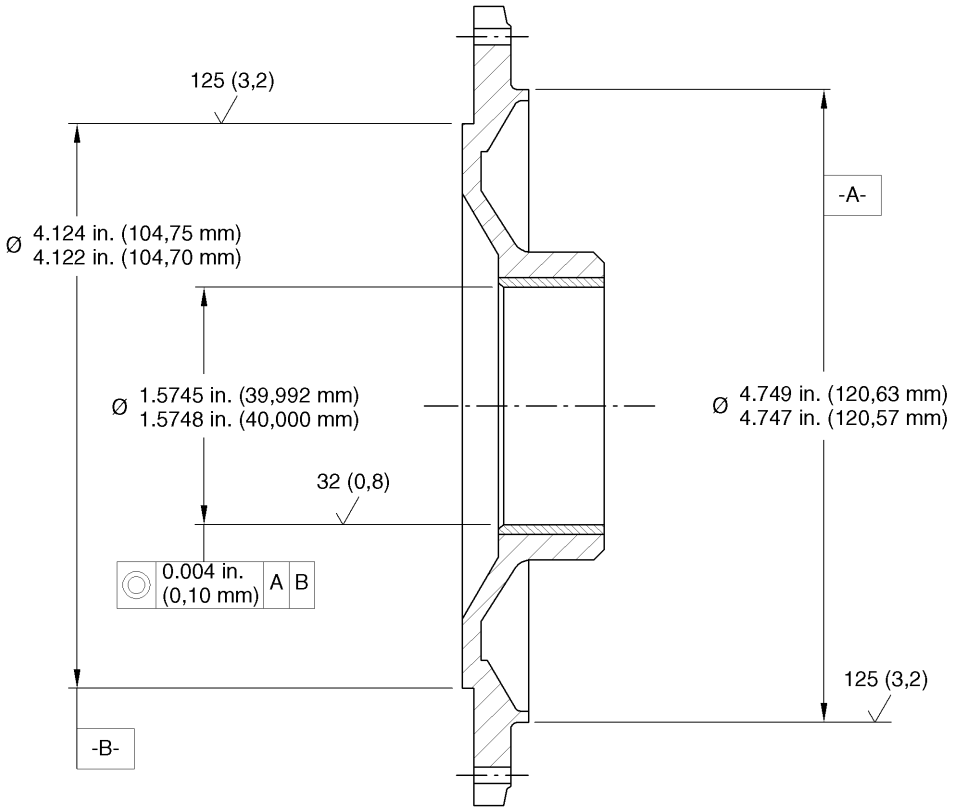


Figure 6002 - Drive End End Bell Bearing Liner Machining Specifications, P/N 23032-1402/-1575s

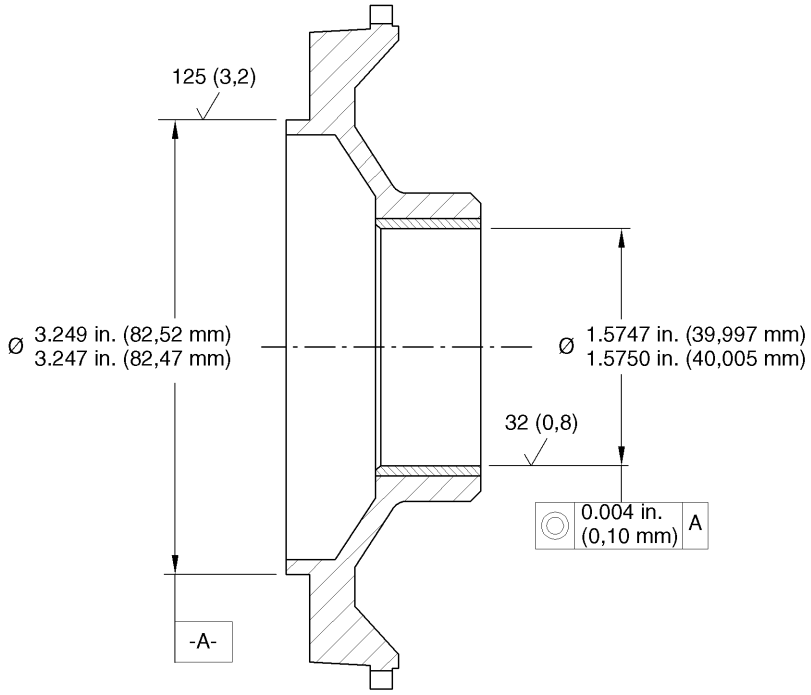


Figure 6003 - Drive End End Bell Bearing Liner Machining Specifications, P/N 23032-1203/-1202

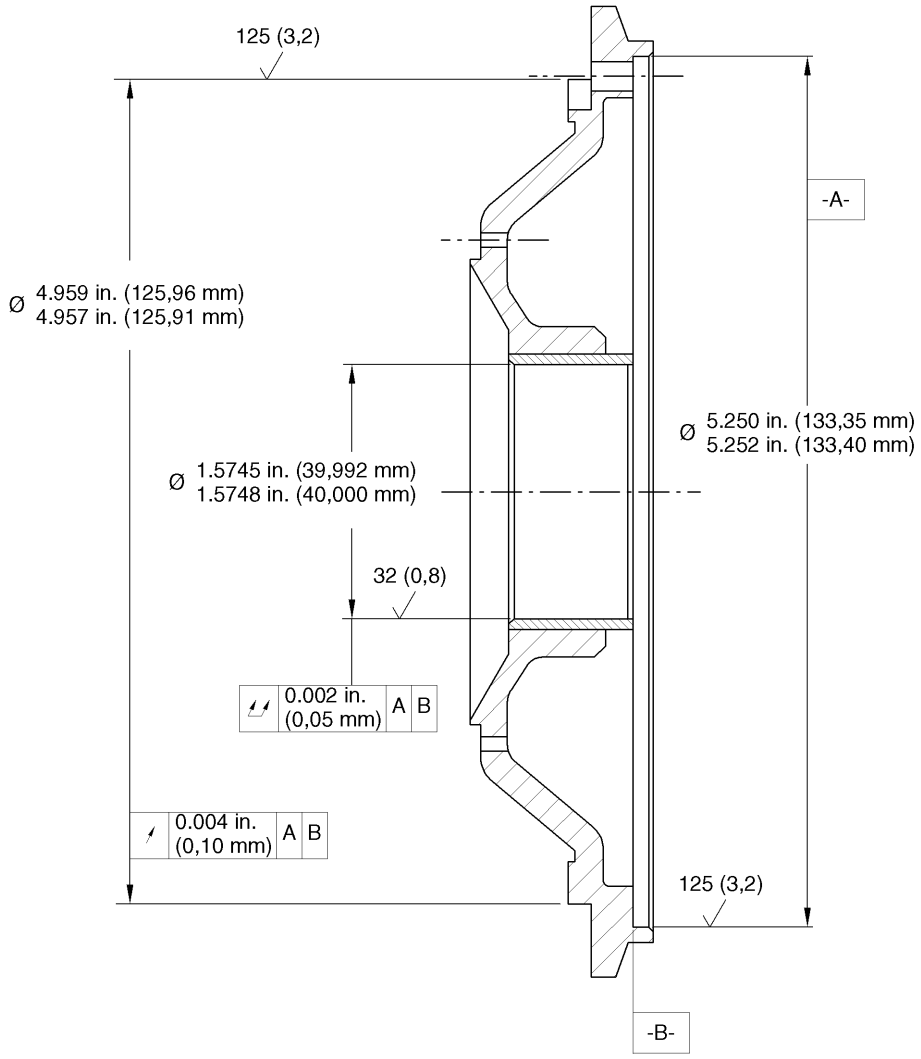


Figure 6004 - Drive End End Bell Bearing Liner Machining Specifications, P/N 23032-2100/-2101/-3651

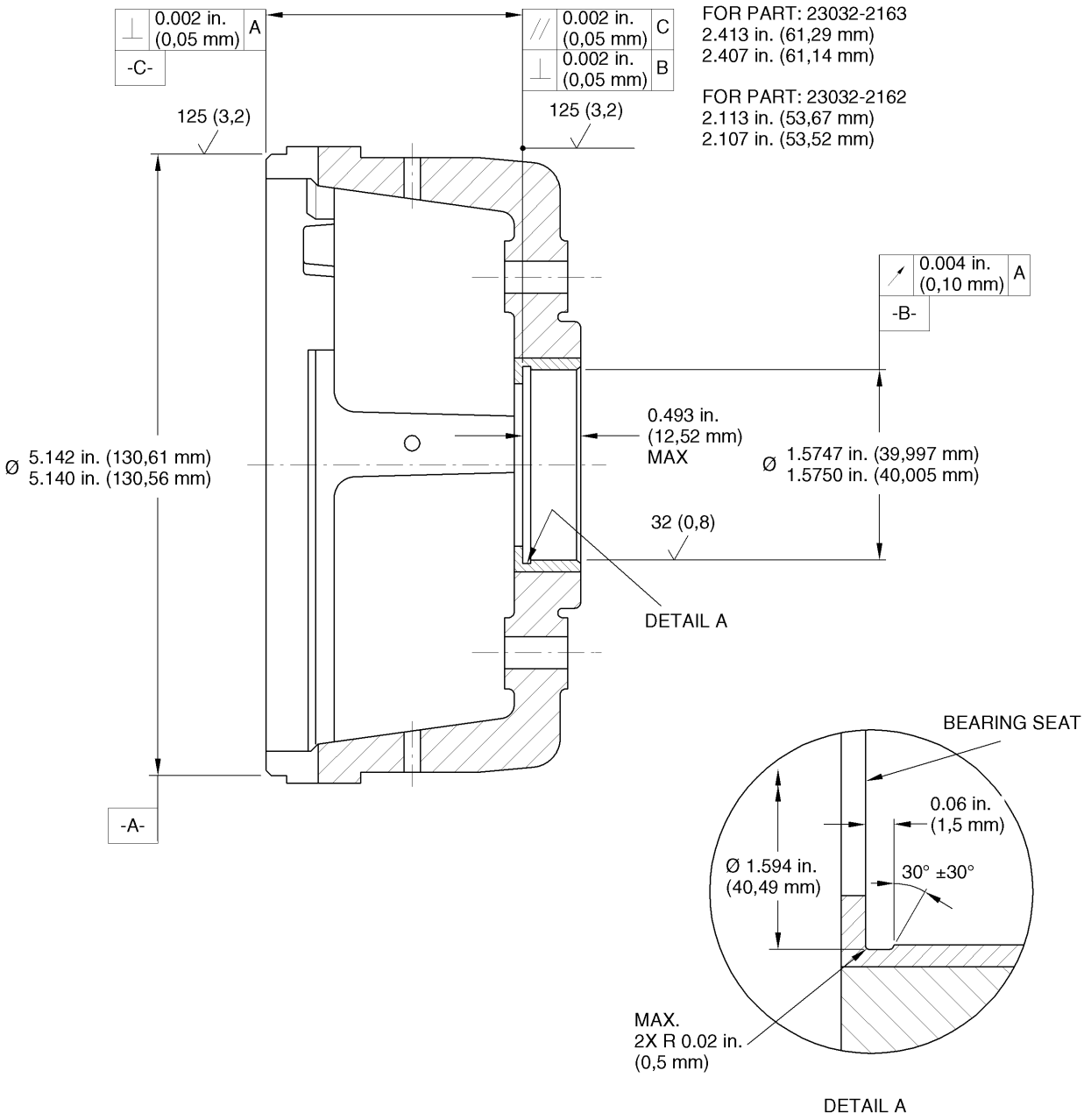


Figure 6005 - Anti-Drive End End Bell Bearing Liner Machining Specifications, P/N 23032-2162/-2163

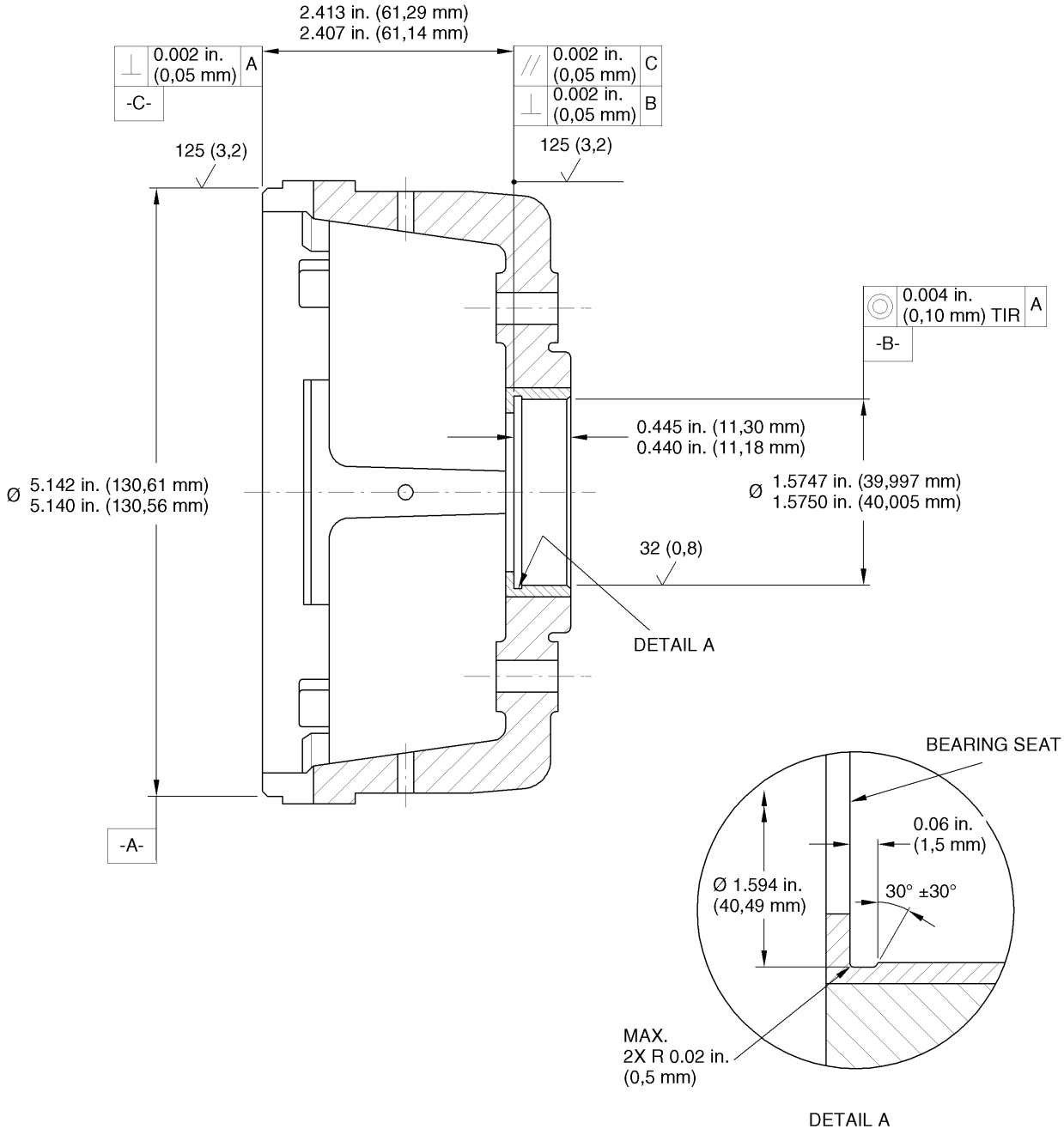


Figure 6006 - Anti-Drive End End Bell Bearing Liner Machining Specifications, P/N 23032-2167

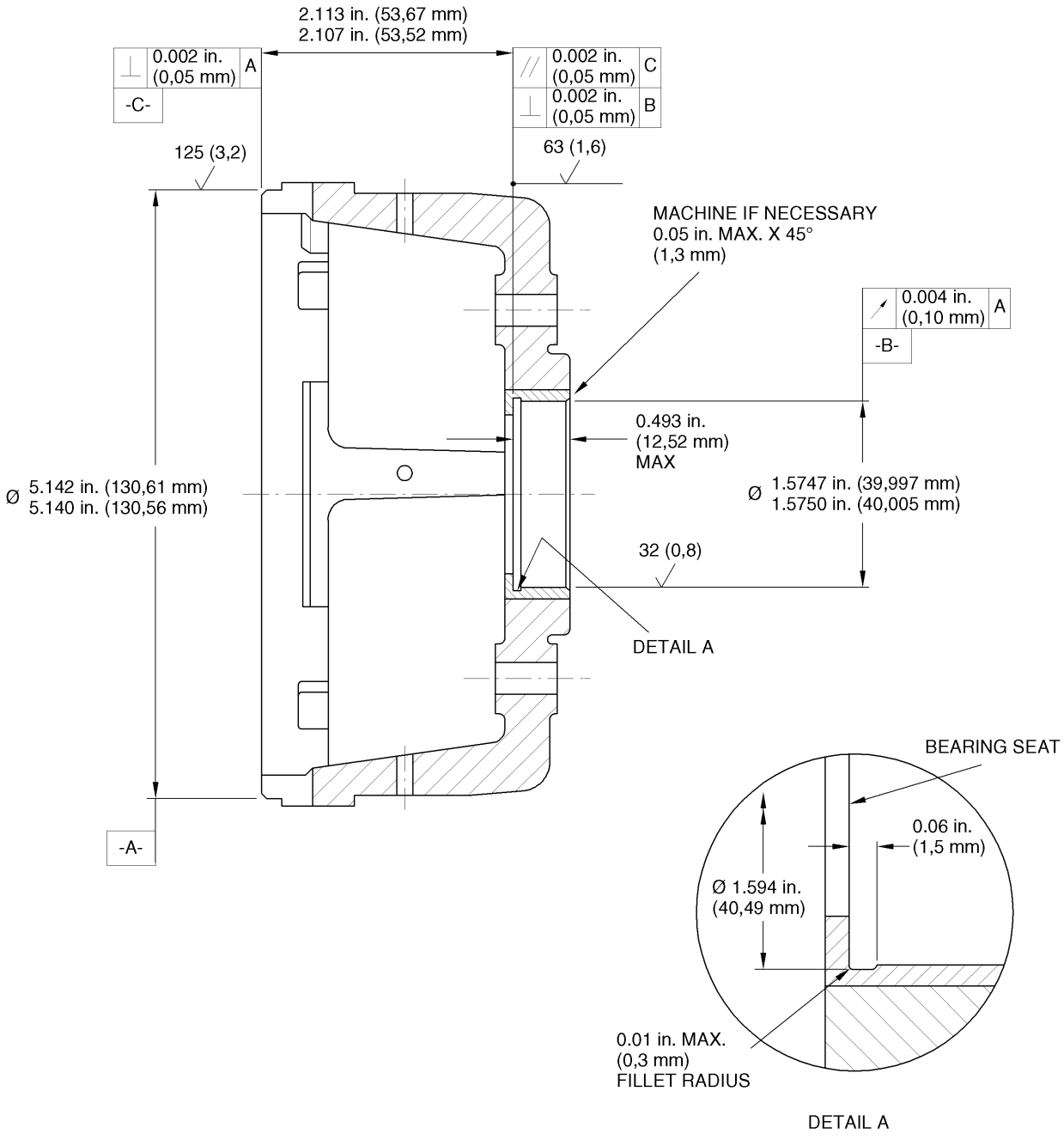


Figure 6007 - Anti-Drive End End Bell Bearing Liner Machining Specifications, P/N 23032-3660

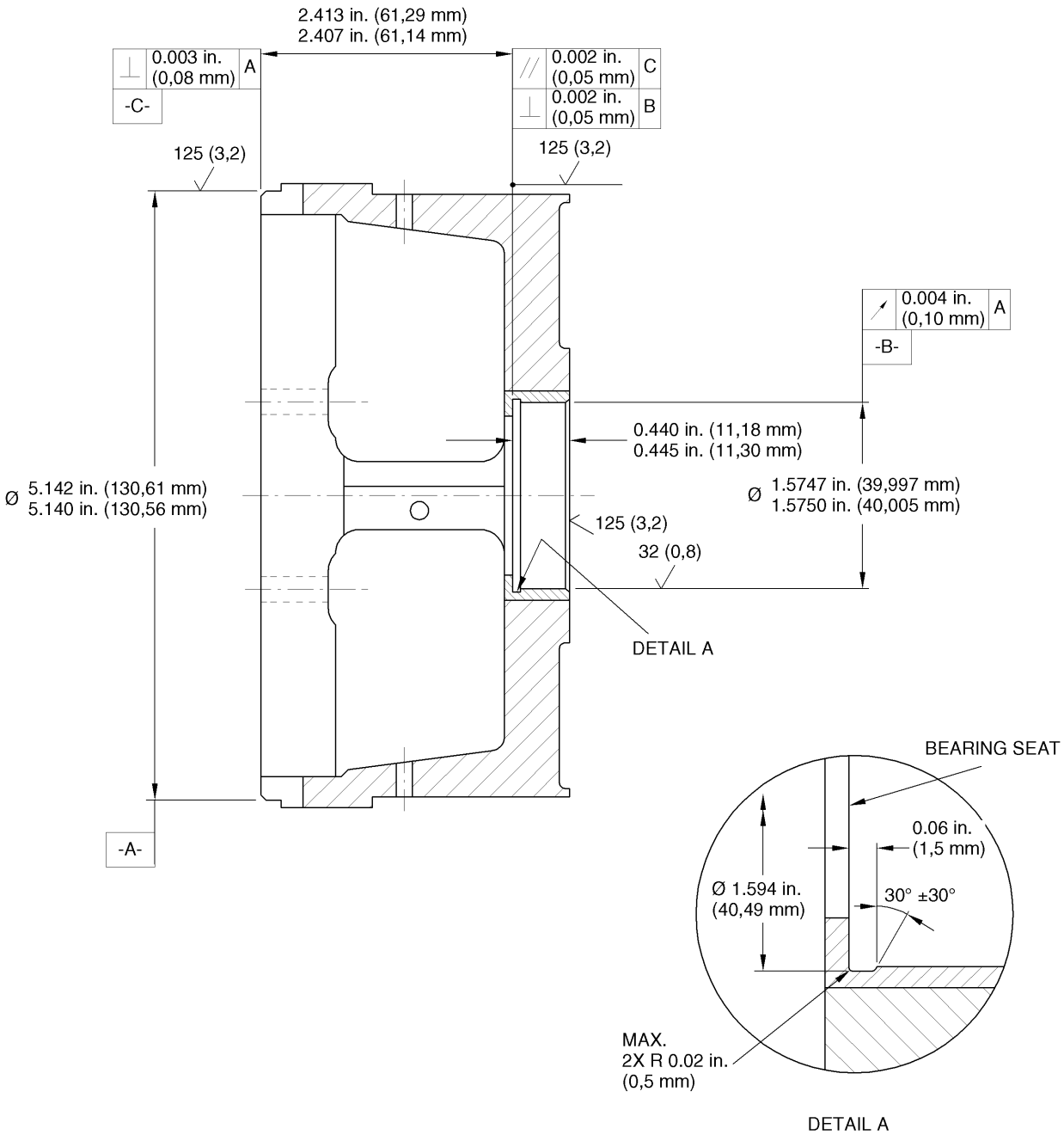


Figure 6008 - Anti-Drive End End Bell Bearing Liner Machining Specifications, P/N 23081-3320/-3322/-3365

8. Commutator Refinishing

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

NOTE: If inspection reveals that commutator is rough, pitted, scored or burned, refinish the commutator on a lathe that is accurately set up and adjusted.

NOTE: Refinish the commutator during each overhaul.

A. Setup

WARNING: WHILE PREPARING MACHINE FOR COMMUTATOR RE-FINISHING, MAKE SURE THAT POWER TO LATHE IS SHUT OFF OR "LOCKED OUT". USE ALL SAFETY PRECAUTIONS WHILE WORKING WITH OR AROUND POWER MACHINE TOOLS. WEAR EYE PROTECTION.

(1) Install a bearing (320) into the commutator turning fixture.

(2) Install commutator turning fixture into tail stock of lathe.

CAUTION: DO NOT TOUCH THE COMMUTATOR WITH YOUR BARE HANDS. CONTAMINATION FROM YOUR SKIN CAN CAUSE CORROSION AND UNSATISFACTORY ELECTRICAL CONTACT.

(3) Insert commutator end of armature into commutator turning fixture.

(4) Position tail stock so that drive end of armature shaft slides into head stock chuck.

(5) Secure tail stock.

(6) Tighten head stock chuck until armature is secure.

B. Repair procedure. Refer to Figure 6009.

CAUTION: DO NOT REMOVE TOO MUCH MATERIAL FROM THE COMMUTATOR. IF YOU DO, THE LIFE OF THE COMMUTATOR WILL BE DECREASED.

CAUTION: DO NOT TOUCH THE COMMUTATOR WITH YOUR BARE HANDS. CONTAMINATION FROM YOUR SKIN CAN CAUSE CORROSION AND UNSATISFACTORY ELECTRICAL CONTACT.

(1) Cut commutator to a surface finish of 64 to 100 micro inches (1,6 to 2,5 microns) rms.

NOTE: The suggested feed rate is 0.006 to 0.007 inches (0,15 to 0,18 mm) per revolution at a surface speed of 1000 to 1500 surface feet per minute (305 to 457 surface meters per minute).

WARNING: **WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, CONTROL PRESSURE TO 29 PSIG (200 KPA) OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES. TAKE PRECAUTIONS TO AVOID INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR USED TO CLEAN OR DRY COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(2) Clean armature (330) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(3) Measure the depth of the mica undercut between the commutator bars. Refer to the FITS AND CLEARANCES section for limits.

(4) If the undercut is out of limits, use a 0.31 to 0.50 inch (7,9 to 12,7 mm) diameter cutter wheel to undercut the mica to a depth of 0.025 to 0.045 inch (0,64 to 1,14 mm) and a width of 0.029 to 0.035 inch (0,74 to 0,89 mm).

NOTE: The beginning of mica undercut must be 0.010 to 0.030 inch (0,25 to 0,76 mm) from the finished face of the risers. All cuts must be equally spaced and parallel with the centerline of the armature shaft within 0.005 inch (0,13 mm) of true position. All mica must be removed from the edges of the undercut.

(5) Use a triangular scraping tool to remove sharp edges and burrs.

(6) Remove undercut residue from between commutator bars with a soft bristle brush.

WARNING: **WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, CONTROL PRESSURE TO 29 PSIG (200 KPA) OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES. TAKE PRECAUTIONS TO AVOID INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR USED TO CLEAN OR DRY COMPONENTS IS FREE FROM OIL AND WATER. THIS WILL PREVENT CONTAMINATION OF THE COMPONENTS.

(7) Clean the armature (330) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(8) After the commutator is refinished:

(a) Measure the commutator bar-to-bar and total indicator reading (TIR) run-out in full circumference of the commutator. Support the armature (330) on two “V” blocks.

(b) Make sure that the armature (330) is balanced IAW procedures found in Paragraph 9.

(9) If the armature (330) cannot be repaired to the limits in the FITS AND CLEARANCES section, replace the armature (330).

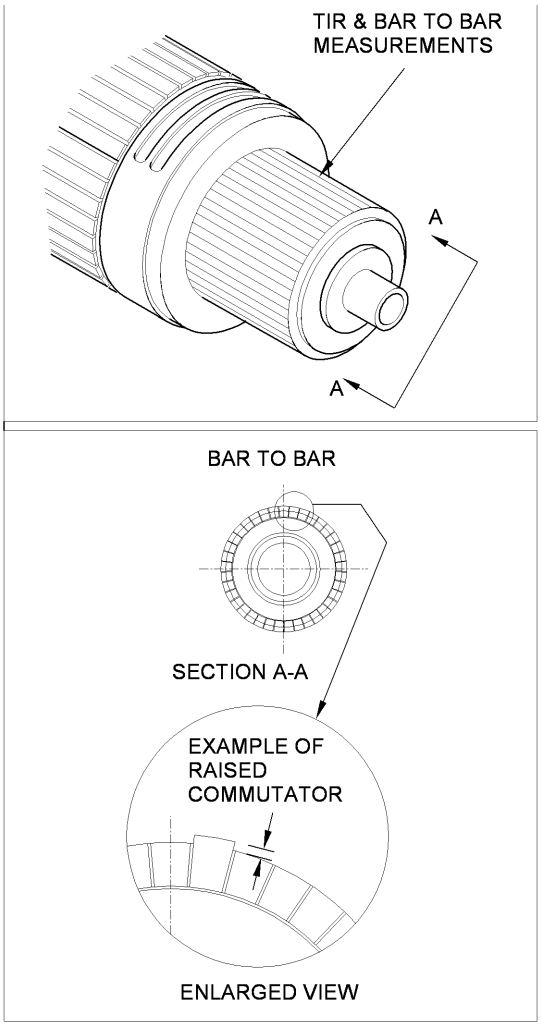


Figure 6009 - Armature Repair

9. Balancing Armature

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of ILLUSTRATED PARTS LIST.

A. Procedure

Balance the armature (330) using the procedure and limits in SPD 1001.

10. Flashing the Field

A. Starter-Generators with reversed polarity in output voltage may be corrected by flashing the field as outlined below.

CAUTION: DO NOT FLASH THE FIELD WHILE STARTER-GENERATOR IS IN OPERATION.

(1) Disconnect leads to external voltage regulator.

(2) Connect negative terminal of battery to terminal “E”. Refer to Figure 6010.

(3) Connect positive terminal of battery to one side of a switch.

(4) Connect other side of switch to terminal “A”.

(5) Close switch for 5 seconds.

(6) Open switch and disconnect it from battery.

NOTE: If flashing the field fails to correct generator polarity, check for incorrect connections or defective field circuit.

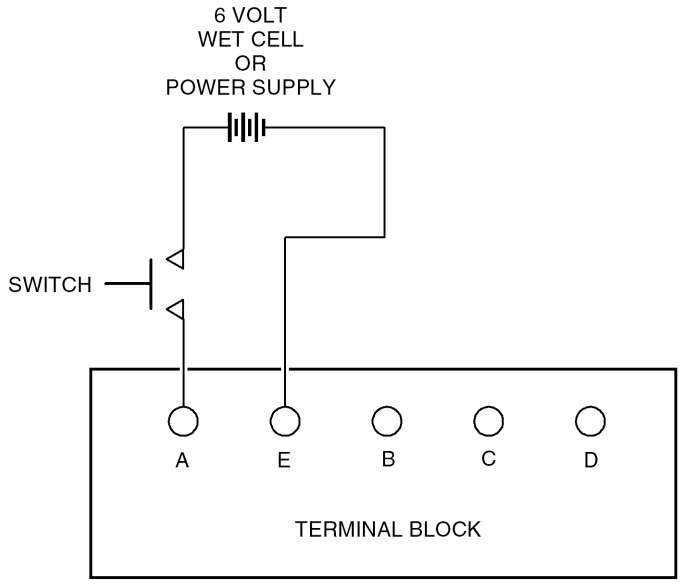


Figure 6010 - Polarizing the Field

11. Fan Cover Repair

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST.

NOTE: On model 23032-062, the internal surface of the fan cover is lined with insulating tape.

A. Replace the insulating tape as follows:

(1) Remove the insulating tape from the fan cover assembly (-70G). Discard the tape.

(2) Clean the fan cover as instructed in the CLEANING section.

(3) Apply new insulating tape to the internal surface of the fan cover as follows:

(a) Position the inner edge of the insulating tape 1.62 to 1.38 inch (41,1 to 35,0 mm) from the screen.

(b) Start at one of the fan cover fixing holes and attach the insulating tape to the inside of the fan cover.

(c) Create a butt joint at the end of the insulating tape. A gap of up to 0.25 inch (6,4 mm) between the ends is permissible.

(d) Trim the insulating tape flush to the open end of the fan cover assembly. Also trim the insulating tape at the four holes.

12. Terminal Lug Replacement

NOTE: Remove and replace damaged terminal lugs (640, 640A, 640B and 645) as needed.

A. Procedure

(1) Cut wire at base of terminal(s). Discard terminal(s).

(2) Strip 0.25 in (6,4 mm) of insulation from end of electrical wire(s).

(3) Use a crimping tool to install new terminal(s).

ASSEMBLY

1. Introduction

This section gives the assembly instructions for 23032 Series of DC Starter-Generators. Assemble starter-generator in a clean work area, away from machining or other metal removing operations. Clean all parts in accordance with procedures in the CLEANING section before final assembly.

In addition to specific procedures authorized by Safran Power in this manual, standard assembly procedures for starter-generators are described in the following Safran Power Standard Practice Documents (SPDs).

- Surface Repair and Coating - Refer to SPD 1002.
- Brush Holder Alignment Fixtures - Refer to SPD 1004.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Assembly Tools

In addition to normal shop tools, the tools listed in Table 7001 are needed for assembly.

Tool Descriptions	Reference
Arbor press	Not illustrated
Armature assembly support - vertical	Figure 9004
Bearing driver, inner race	Figure 9003
Bearing driver, outer race	Figure 9002
Bearing hub support	Figure 9001
Dampener plate driver	Figure 9006
Heat gun	Commercially available
Leather or plastic mallet	Commercially available
Ohmmeter	Commercially available
Retaining ring pliers	Commercially available
Spline wrench	Figure 9007
Stator and housing assembly support - horizontal	Figure 9008
Stator and housing assembly support - vertical	Figure 9009
Torque wrench	Commercially available
Wire hook tool	Commercially available

Table 7001 - Assembly Tools

3. Assembly Materials

Table 7002 lists the materials required to assemble the generator.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source
Alcohol, Isopropyl	TT-I-735, Grade A See **WARNING** before using this material. Flash point: 53° F (12° C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information.	Commercially available
Brush, Soft Bristle, Non-metallic		Commercially available
Coating, Acrylic	MIL-I-46058/HumiSeal 1B31, Type AR	Chase Corporation Woodside NY 11377 (VOSR97)
Compound, Sealing, Thread	Gasoila, Soft Set (Safran Power Ref. 05-648318)	GSA Supply on-line www.gsasupplyco.com or Federal Process Co. 4620 Richmond Road Beachwood OH 44128 (V97785)
Enamel, Red Insulating, Baking	Synthite ER-41	John C. Dolph Company 320 New Road PO Box 267 Monmouth NJ 08852 (V72688)
Grease	MIL-G-81322	Commercially available
Pads, Cleaning	Lint-free cotton	Commercially available

Table 7002 - Assembly Materials

Item	Description/Specification	Source
Paper	Protective/MIL-B-121A, grade A, type II, class I	National Paper & Packaging Inc. 99 Hackensack Ave. Kearny NJ 07032 (V3RUSO)
Primer, Zinc Chromate	TT-P-1757, Composition G, Color Y	Commercially available
Lubricating and Assembly Paste	Altemp QNB50 **FLAMMABLE.** Read the **WARNING** before using this material. Refer to the applicable MSDS for additional safety information	Kluber Lubrication 32 Industrial Dr. Londonderry, NH 03053 (V3EZL6)
Sandpaper	180 grit (non-aluminum oxide)	Commercially available

Table 7002 - Assembly Materials (Continued)

4. Assemble Stator and Housing Assembly (550)

The following procedure details the assembly of the stator and housing assembly.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Install terminal block assembly (600) if it was removed at disassembly (Figure 7001).

NOTE: Before acceptance testing, attach an unserviceable terminal block to the stator and housing assembly. Acceptance testing can damage the internal capacitors of a terminal block (600).

NOTE: Alternatively, if the original terminal block is used, the grounding lead screw can be removed and the grounding lead must be protected with electrical tape.

(1) Position terminal block (600) on stator and housing assembly (550) with stator leads positioned on terminal block studs.

(2) Install two screws (610), lock washers (620) and plain washers (630) to secure terminal block to stator housing.

(3) Tighten the screws (610) to a torque of 28.0 to 37.6 lbf.in (3,2 to 4,2 N•m).

NOTE: Do not install the grounding lug if the original terminal block will be used during acceptance test.

(4) Secure stator leads B, C, and E to large terminals with washers (590) and nuts (580).

(5) Secure stator leads A+ and D to small terminals with washers (570) and nuts (560).

NOTE: Do not tighten the nuts (560) on terminals A+ and D. They will be tightened at the time of installation into the aircraft. It is necessary to install the wires from the GCU at that time.

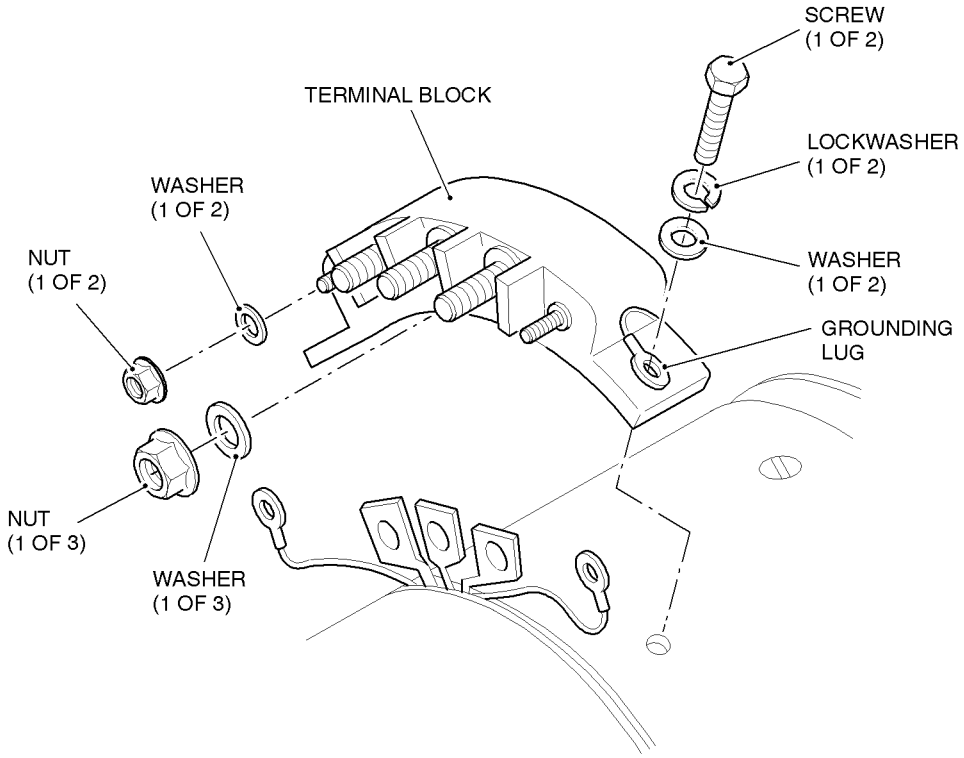


Figure 7001 - Terminal Block Attachment

5. Assemble Bearing and Brush Support Assembly (370)

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Install brush holder assembly (-420) and filter board assembly (450) on anti-drive end bell (540).

CAUTION: DO NOT WIND SPRING FURTHER THAN NECESSARY TO INSTALL IN POSITION, OR SPRING MAY TAKE A PERMANENT SET, AND PRODUCE INSUFFICIENT PRESSURE ON BRUSH.

(1) Install two springs (520) on brush holder (530). Each spring must be wound approximately 3/4 turn before installation on brush holder spring support bar.

(2) Insert insulation sleeve (440) into each of two brush holder mounting holes in anti-drive end bell (540).

(3) On all models except 23032-025,-026,-027,-028,-042,-043,-044,-048 and -049, place a flat washer (490) on each of the two screws (430) and insert screws through insulation sleeves (440) in end bell (540).

(4) For models 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054 and 23032-062 also place a non-metallic washer (500) on each of the two screws (430).

(5) On brush holder side of end bell, position non-metallic washers (480) on top of screws (430).

(6) Orient end bell as shown in Figure 7002 (recess in casting facing up). Position brush holder assembly (-420) over screws (430) and against non-metallic washer (480).

NOTE: Models 23032-010, 23032-011, 23032-018, 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062 use two filter board assemblies (450) that are installed 180 degrees apart, between adjacent brush holders.

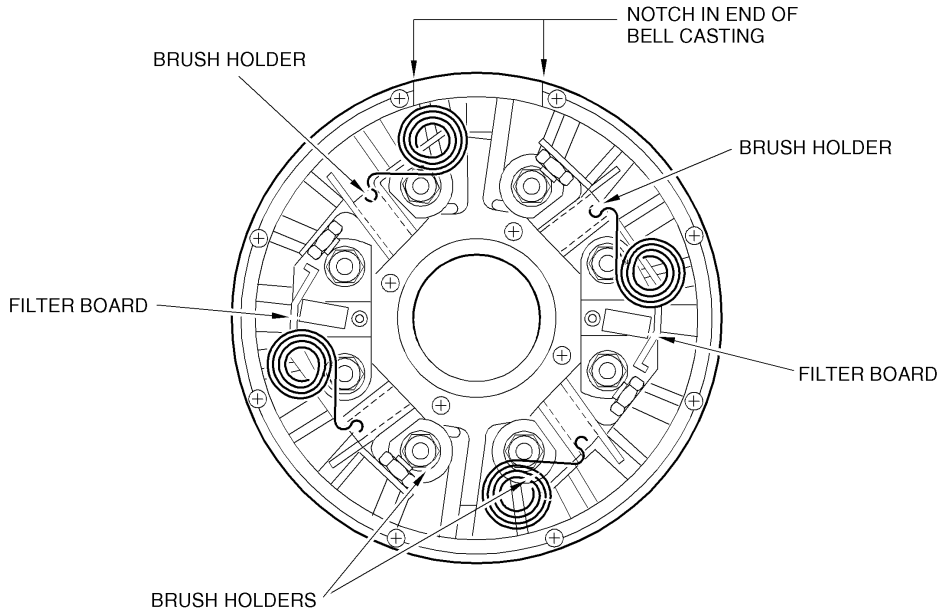


Figure 7002 - Filter Board Installation

(7) On units using filter board assemblies (450) proceed as follows: (See Figure 7002).

(a) On screw (430) at end of brush holder not having filter board assembly attached, install non-metallic washer (470), washer (490), and self-locking nut (510) to hold brush holder in place.

(b) On opposite brush holder screw, position one end of filter board assembly (450) as shown in Figure 7002. Loosely install washer (490) and nut (510) to hold filter board assembly. Position opposite end of filter board assembly over brush holder screw of adjacent brush holder.

(c) Repeat Steps (a) and (b) for remaining brush holders and filter board assembly.

(d) Tighten brush holder screws (430) 25 to 30 lbf.in. (2,83 to 3,39 N·m).

(e) On Models 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062, route filter board assembly (450) ground leads through openings in end bell casting in preparation for attachment to bearing retainer (340) in Paragraph 9.A.

(8) On units that do not use filter board assemblies, install insulating washers (470), washers (490), and self-locking nut (510) to complete brush holder installation.

B. Install new bearing into anti-drive end bell (540). Refer to Figure 7003.

(1) Apply lubricating and assembly paste to the inside diameter of the bearing liner in the anti-drive end bell (540).

(2) Using an arbor press, bearing hub support (Figure 9001), and outer race bearing driver (Figure 9002), press new ball bearing (320) into the anti-drive end bell (540).

C. Install bearing retainer on the bearing and brush support assembly

(1) On all models except 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062, secure bearing (320) in end bell by installing bearing retainer (340), four screws (350) and lock washers (360).

(2) On models 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062, secure bearing (320) in end bell by installing bearing retainer (340), four screws (350) and lock washers (360).

NOTE: Screws that attach the filter assembly leads will be fully tightened after acceptance testing is done.

NOTE: Thread sealing compound will be installed on the screws that attach the bearing retainer after acceptance test is completed.

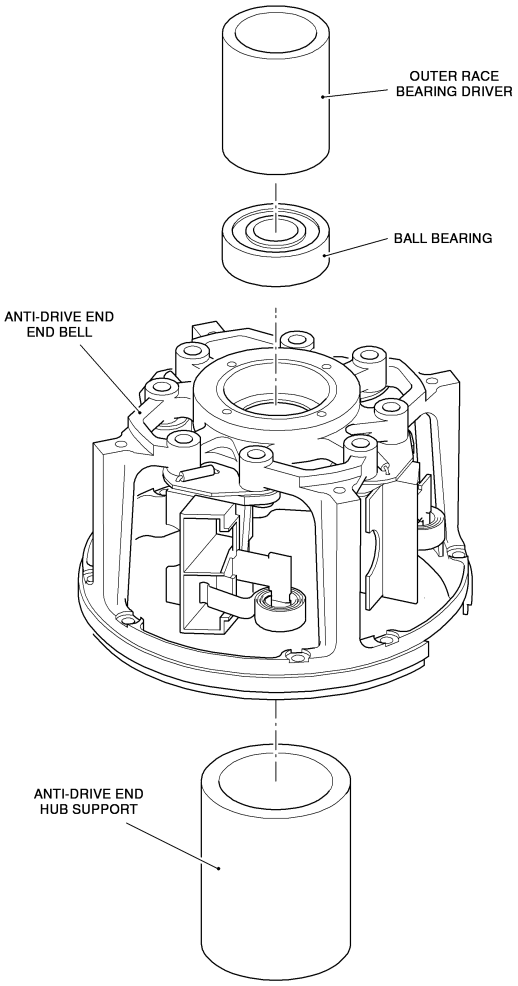


Figure 7003 - Assembling Ball Bearing in Anti-Drive End Bell

D. Coat brush holder components with red insulating enamel on Models 23032-010, 23032-011, 23032-018, 23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048 and 23032-049.

WARNING: INSULATING ENAMEL IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN A WELL VENTILATED AREA FREE FROM SPARKS, FLAME AND/OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

(1) Apply red insulating enamel to bearing and brush support assembly according to the procedure in SPD 1002.

6. Assemble Armature (330)

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Install baffle discs (310), bearing (320), and retaining ring (300) on armature shaft. See Figure 7004.

(1) Install one baffle disc (310) with recessed surface of disc facing windings, on drive end of armature (330) shaft.

(2) Using armature support (Figure 9004), and inner race bearing driver (Figure 9003), press a new bearing (320) onto drive end of armature shaft. Bearing must be fully engaged against inner baffle disc (310).

(3) Install remaining baffle disc (310) on drive end of armature shaft with recessed surface of disc facing away from armature.

(4) Install retaining ring (300) in groove on armature shaft drive end. Make certain that ring fully engages the groove.

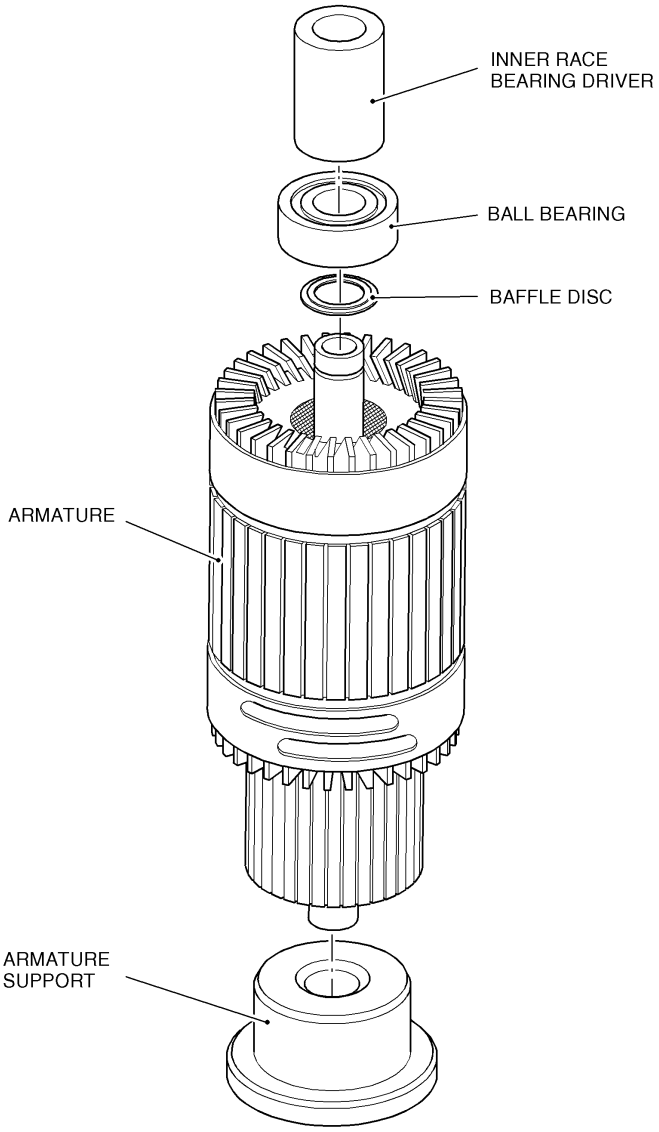


Figure 7004 - Baffle Disc and Ball Bearing Installation on Drive End of Armature Shaft

7. Final Assembly of the Starter-Generator

The following procedure details the final assembly of the starter-generator.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Prepare armature for coarse brush seating.

(1) Prepare the armature for coarse brush seating. Refer to SPD 1006.

NOTE: Make sure taped end of sandpaper is in the normal direction of rotation and abrasive side of sandpaper faces away from the commutator. See Figure 7005.

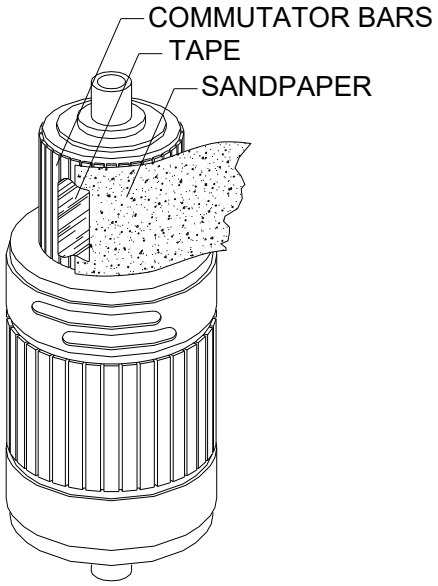


Figure 7005 - Preparing Armature for Rough Seating

B. Assemble bearing and brush support assembly (370) and armature assembly (330). See Figure 7006.

(1) Place armature (330) in the vertical armature assembly support (Figure 9004) on an arbor press.

(2) Position bearing and brush support assembly (370) with assembled bearing and retainer on commutator end of armature shaft by pressing on inner race of bearing (320). Make sure that armature bearing is properly seated in bearing liner.

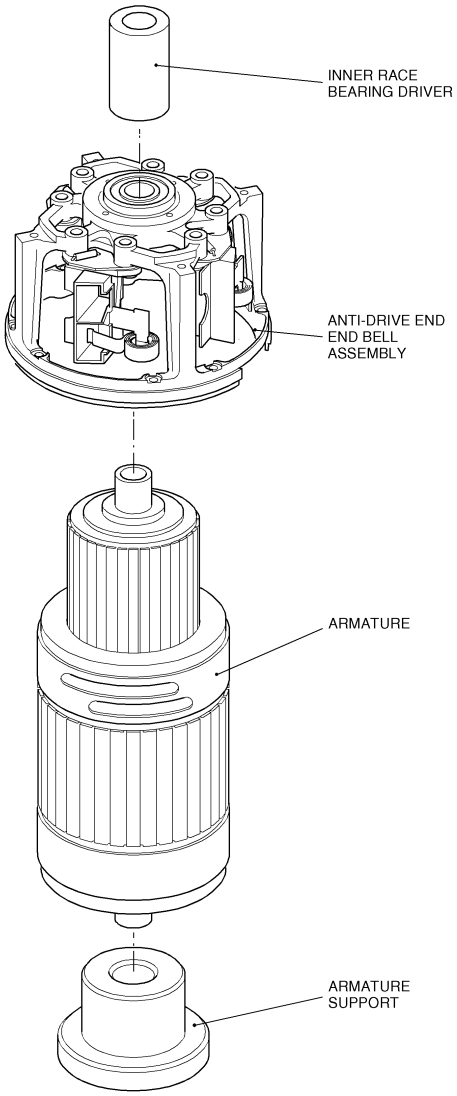


Figure 7006 - Attaching Anti-drive End End Bell Assembly to Armature

C. Install armature assembly (330) and bearing and brush support assembly (370) into stator assembly (550). See Figure 7007.

(1) Position armature and bearing and brush support assembly on stator and housing assembly (550).

WARNING: THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(2) Apply thread-sealing compound to threads of eight screws (380).

(3) Install screws (380), lock washers (390), and washers (410) as follows:

(a) For Models 23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, and 23032-049 only.

WARNING: KEEP ZINC CHROMATE PRIMER AWAY FROM SOURCES OF IGNITION. ZINC CHROMATE PRIMER IS FLAMMABLE.

WARNING: DO NOT GET ZINC CHROMATE PRIMER ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ZINC CHROMATE PRIMER IS A POISONOUS MATERIAL.

1 Coat the face of two-tooth lock washers (-400) with zinc chromate primer.

2 Place washers on two screws (380) with coated face away from screw head, and install screws into end bell 180 degrees apart. Make sure coated face of washer is against end bell assembly.

3 Install six remaining screws (380), lock washers (390), and washers (410).

(b) For all other models, install eight screws (380), lock washers (390), and washers (410).

(c) Torque tighten screws (380) 18 to 24 lbf.in (2,03 to 2,71 N·m).

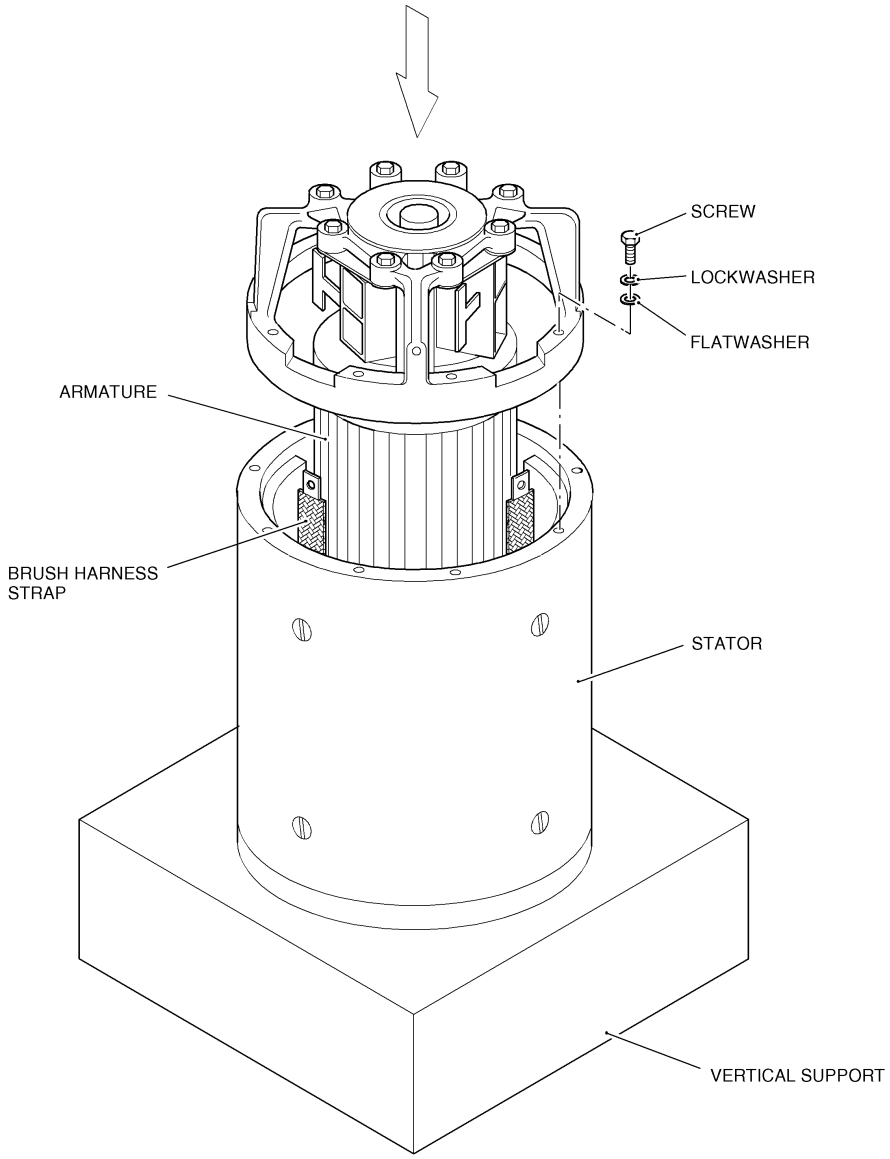


Figure 7007 - Install Armature Assembly and Bearing and Brush Support Assembly in Stator and Housing Assembly

D. Install drive-end end bell/drive end bearing support assembly (210).

(1) Drive-end bearing support assembly only. If removed, attach screen (270) with four drive screws (280) and washers (290).

(2) Apply lubricating and assembly paste to the inside diameter of the bearing liner in the drive-end end bell.

(3) Position drive end end bell/drive end bearing support assembly (210) on stator and housing assembly (540). Ensure that end bell assembly is fully seated on bearing (320).

WARNING: THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

(4) Apply thread-sealing compound to threads of eight screws (220).

(5) Install screws (220), lock washers (230), and washers (250) as follows:

(a) For Models 23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, and 23032-049 only.

WARNING: KEEP ZINC CHROMATE PRIMER AWAY FROM SOURCES OF IGNITION. ZINC CHROMATE PRIMER IS FLAMMABLE.

WARNING: DO NOT GET ZINC CHROMATE PRIMER ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ZINC CHROMATE PRIMER IS A POISONOUS MATERIAL.

1 Coat the face of two-tooth lock washers (-240) with zinc chromate primer.

2 Place washers on two screws (220) with coated face away from screw head, and install screws into end bell 180 degrees apart. Make sure coated face of washer is against end bell assembly.

3 Install six remaining screws (220), lock washers (230), and washers (250).

(b) For all other models, install eight screws (220), lock washers (230), and washers (250).

(c) Torque tighten screws (220) 18 to 24 lbf.in (2,03 to 2,71 N·m).

E. Install dampener backplate (190), friction ring (180), dampener hub (160), and dampener plate (170). See Figure 7008.

CAUTION: DO NOT USE AN ARBOR PRESS TO FORCE DAMPENER BACK PLATE ONTO ARMATURE SHAFT OR DAMPENER HUB ONTO DRIVE SHAFT. PROPER TIGHTENING OF NUT (130) PRODUCES CORRECT SEATING OF THESE COMPONENTS.

(1) Hand twist the dampener backplate (190) onto the drive end of the armature shaft until it is fully seated on shaft taper. (See Figure 7008).

(2) Place the friction ring (180) in recess of dampener backplate (190).

(3) If dampener hub (160) was removed from drive shaft (120), place hub on shaft making certain that hub taper is fully seated on drive shaft taper by wringing it onto the shaft taper by hand.

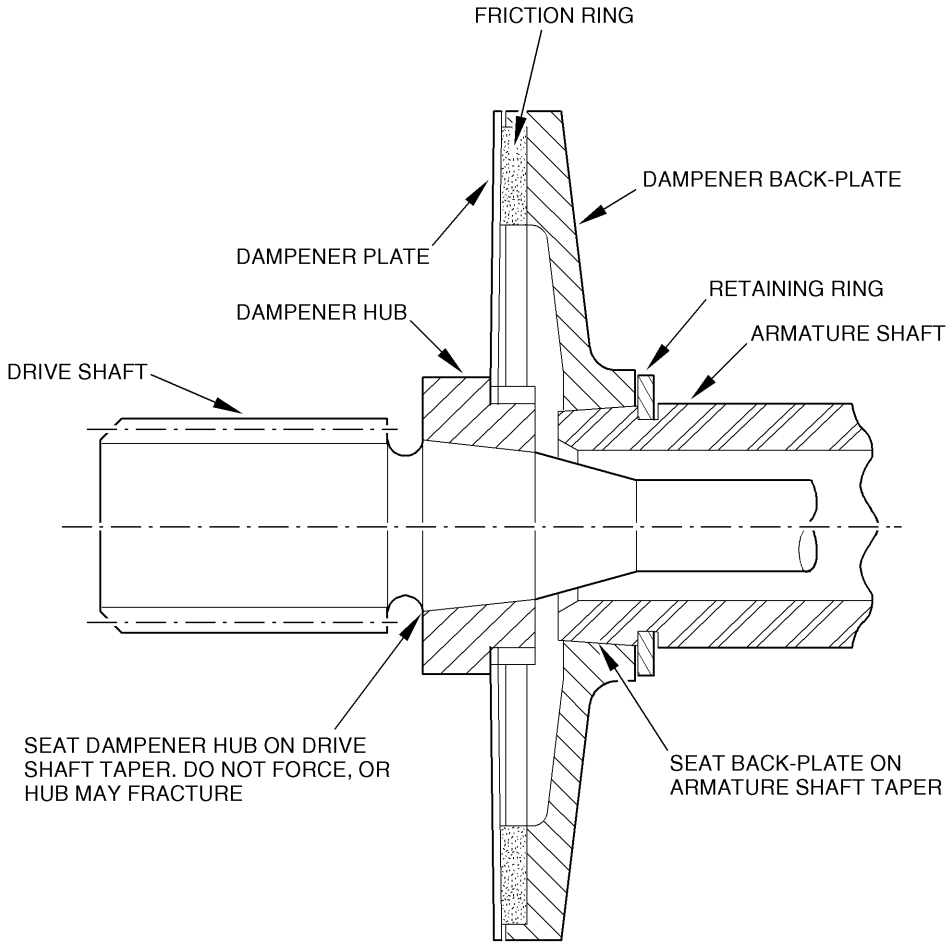


Figure 7008 - Cross Sectional View of Dampener Assembly

(4) See Figure 7009. Set the dampener plate onto dampener plate driver (Figure 9006).

(5) Insert the drive shaft (120) through the dampener plate and dampener plate driver while aligning the splines of dampener plate (170) and dampener hub (160).

(6) Lightly tap the drive end of the drive shaft using a leather or plastic mallet to seat the dampener plate onto the dampener hub.

(7) Make certain that dampener plate (170) fully bottoms on shoulder of dampener hub (160).

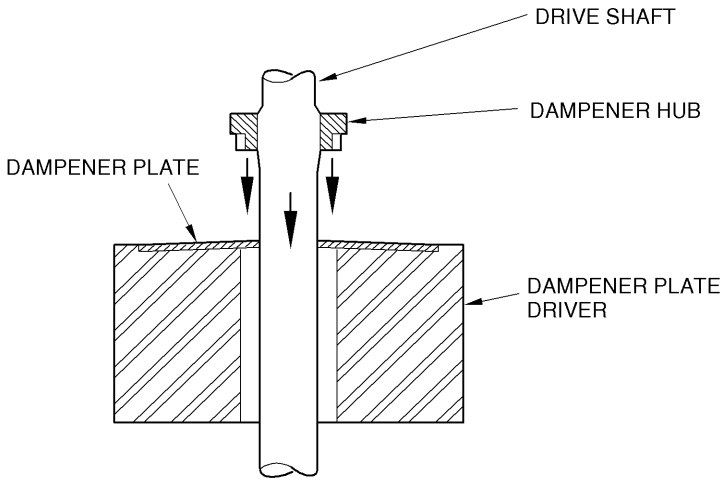


Figure 7009 - Dampener Hub and Plate Installation

F. Install drive shaft (120) and fan assembly (200).

(1) Insert drive shaft (120) through drive end of armature, making certain that drive shaft splines fully engage armature shaft splines. See Figure 7010.

(2) Position fan assembly (200) on drive shaft and secure with flat washer (140) and self-locking nut (130). See Figure 7011.

(3) Use a suitable spline wrench (Figure 9007) to hold drive shaft (120) and torque tighten nut (130) 100 to 120 lbf.in (11,3 to 13,6 N·m).

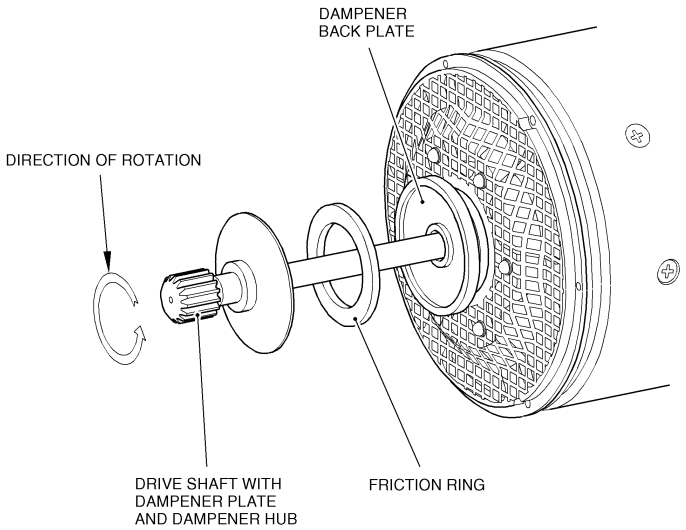


Figure 7010 - Installing Drive Shaft into Armature Shaft

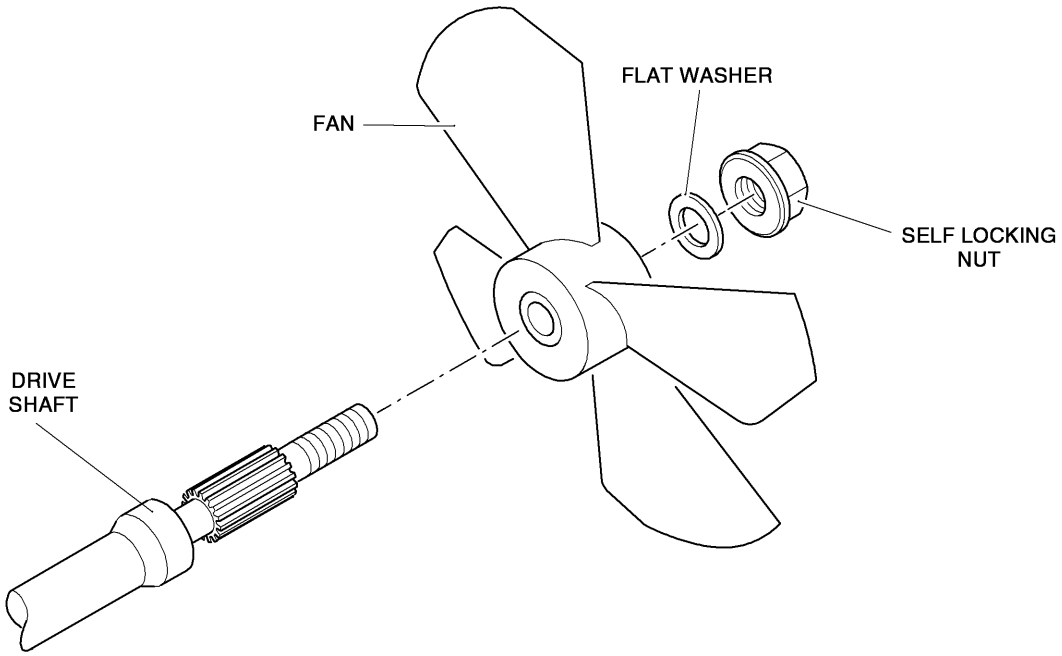


Figure 7011 - Installing the Fan

G. Install brushes (100) into starter-generator. See Figure 7012.

NOTE: If new brushes (100) are to be used, identify the brushes with the numbers 1 through 4.

CAUTION: RAISE AND LOWER BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO INSERT BRUSH SETS INTO BRUSH HOLDER ASSEMBLY.

(1) Set starter-generator, anti-drive end up, onto a vertical stator support.

(2) At each brush holder location, lift one brush spring at a time with a wire hook tool and insert brush set into a brush holder assembly.

(3) Slowly lower springs on top of brushes. Make sure that brush leads are not caught under brush springs.

(4) Secure the four brush leads and four braided stator leads to the complete brush holders with four screws (110) to a torque of 22.7 to 35.0 lbf.in (2,6 to 4,0 N·m).

CAUTION: FAILURE TO PROPERLY FORM THE BRUSH LEADS CAN RESULT IN BRUSH HANG UP.

(5) Form the brush leads IAW SPD 1006.

NOTE: Also reference GSIL 2007-01 for brush lead installation instructions for applicable models.

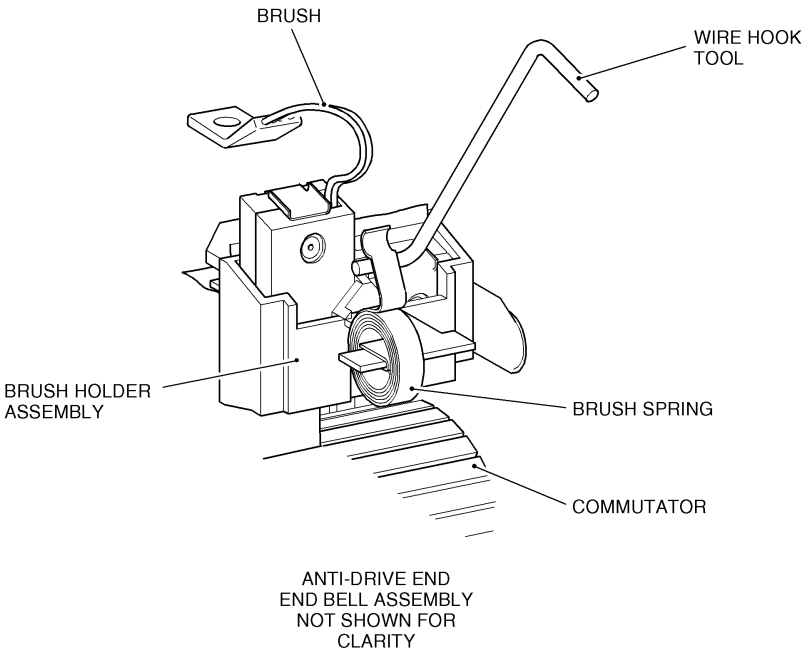


Figure 7012 - Installing Brushes

H. Coarse seat new brushes (100).

CAUTION: FAILURE TO FULLY SEAT BRUSHES CAN DECREASE BRUSH LIFE, LOWER STARTER-GENERATOR PERFORMANCE, OR CAUSE STARTER-GENERATOR FAILURE.

(1) Coarse seat brushes per Safran Power Standard Practices Document (SPD) 1006.

NOTE: The sandpaper should first touch the leading edge (short side) of the brush when the armature is rotated in its normal direction.

(2) Remove any remaining sandpaper IAW SPD 1006 when done with brush seating.

I. Perform brush (100) run-in.

CAUTION: FAILURE TO FULLY SEAT THE BRUSHES CAN DECREASE BRUSH LIFE, LOWER STARTER-GENERATOR PERFORMANCE, OR CAUSE STARTER-GENERATOR FAILURE.

CAUTION: DO NOT LET THE STARTER-GENERATOR HANG UNSUPPORTED DURING INSTALLATION ONTO AND REMOVAL FROM THE DRIVE STAND. TOO MUCH LOAD ON THE DRIVE SHAFT SHEAR SECTION CAN DAMAGE THE UNIT.

(1) Run-in the brushes as given in Safran Power SPD 1006.

NOTE: A correctly seated brush (100) has a smooth and semi-gloss contact surface.

J. Perform bonding test for Models 23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, and 23032-044.

Bonding resistance must be less than 0.001 Ω any one of the two following paths:

(1) Using an ohmmeter, check resistance between drive-end end bell screen (270) on drive-end bearing support assembly (210) and head on terminal block mounting screw (610).

NOTE: Contact point for check on fan cover assembly (70) must be on the bare metal or cadmium plate surface of the cover.

(2) Check resistance between fan cover assembly (70) and head on terminal block mounting screw (610).

K. Perform bonding test for Models 23032-048 and 23032-049.

(1) Bonding resistance must be less than 0.001 Ω between anti-drive end end bell assembly (210) and drive-end end bell mounting flange.

L. If removed, attach identification plate (10), information plate (40) and decal (30) to the generator.

NOTE: See the ILLUSTRATED PARTS LIST for the applicable model and modification status when re-identifying a starter-generator.

NOTE: If removed, the identification plate will be damaged.

CAUTION: DO NOT STAMP INFORMATION DIRECTLY ONTO ANY PART OF THE STATOR AND HOUSING ASSEMBLY.

(1) Put a new replacement identification plate (10) on a wooden work surface.

(2) Transfer all information from the original plate to the replacement plate using a $^{1}/_{8}$-inch (3,18 mm) letter punch set and a light hammer.

NOTE: Insert a stainless steel strip under the plate to absorb impact and prevent puncture of the plate.

(3) Discard the original plate.

(4) Stamp the letter 'X' under the applicable letters on the replacement identification plate to indicate the modification status.

(5) Attach the identification plate to the stator and housing assembly (550), where the original plate was positioned, using four drive screws (20).

WARNING: KEEP ACRYLIC COATING AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. CONFORMAL COATING IS FLAMMABLE.

WARNING: DO NOT GET ACRYLIC COATING ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ACRYLIC COATING IS A POISONOUS MATERIAL.

(6) Apply acrylic coating to the replacement identification plate.

(7) If removed, attach a new information plate (40) to the stator and housing assembly (550), oriented to read in the same direction as the identification plate, with two drive screws (50).

NOTE: The information plate, if applicable, is positioned either to the left or below the identification plate. Use the two drive screw holes for guidance.

WARNING: KEEP ACRYLIC COATING AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. CONFORMAL COATING IS FLAMMABLE.

WARNING: DO NOT GET ACRYLIC COATING ON YOUR SKIN AND DO NOT BREATHE THE FUMES. ACRYLIC COATING IS A POISONOUS MATERIAL.

(8) Apply acrylic coating to the new information plate.

WARNING: **ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA.**

(9) If removed, clean the area on the stator and housing assembly (550) for the decal (30) using isopropyl alcohol.

(10) Apply the new decal (30) to the stator and housing assembly (550) next to the terminal block.

WARNING: **ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA.**

(11) For models 23032-048 and 23032-049, clean the area on the stator and housing assembly (550) for the FAA-PMA label (-60) using isopropyl alcohol. Apply the new label near the identification plate (10), and oriented to read in the same direction.

8. Mandatory Acceptance Testing

Test the starter-generator according to procedures in the TESTING AND FAULT ISOLATION section before it is returned to service or stored.

9. Assembly After Acceptance Testing

A. Complete bearing retainer installation for Models 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, and 23032-062. See Figure 7013.

(1) Remove the four bearing retainer screws (350) and lock washers (360).

(2) Position filter leads from the filter assembly over empty holes in bearing retainer (340).

WARNING: **THREAD SEALING COMPOUND IS DANGEROUS TO PERSONS. USE ONLY IN AN AREA WITH A GOOD FLOW OF AIR. KEEP AWAY FROM SOURCES OF IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.**

(3) Apply thread-sealing compound to threads of removed screws.

(4) Install the screws (350) and lock washers (360).

(5) Tighten all four bearing retainer screws to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m).

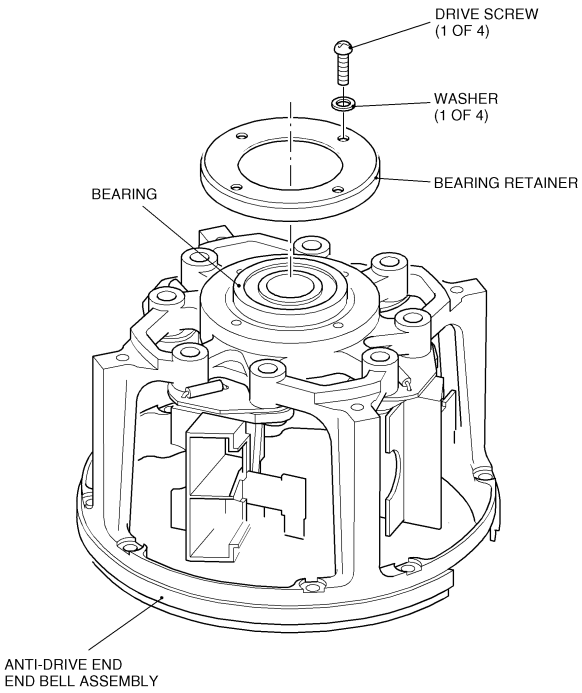


Figure 7013 - Attaching Bearing Retainer

B. Install serviceable terminal block.

(1) Refer to Paragraph 4.A.(1) to install a serviceable terminal block if a dummy terminal was used.

(2) If the grounding lead was removed, re-install the grounding lead with attaching hardware following Paragraph 4.A.(1).

C. Put the attaching hardware onto the terminal block.

D. Attach fan cover (70).

(1) Position fan cover (70) on stator housing and secure with four screws (80).

(2) Tighten the screws (80) to a torque of 7.7 to 10.3 lbf.in (0,87 to 1,16 N·m).

E. Attach QAD kit to starter-generator

NOTE: When the starter-generator has been removed from service, the QAD kit usually stays on the aircraft.

(1) Assemble the end bell drive end pad (660) to the drive end of the starter-generator.

(2) Install rim clenching clamp (670) and tighten self-locking hex nut to the torque value stamped on the clamp.

10. Preparation for Shipment/Storage

After mandatory acceptance testing is completed, prepare starter-generator for shipment or storage.

11. Package the generator for shipment or storage

Coat drive spine with grease MIL-G-81322 and wrap the drive spline with protective paper according to MIL-B-121A, Grade A, Type II, Class 1.

For models using an O-ring (150) on the drive shaft, place a new O-ring into a suitable container and label container with instructions to user to lubricate and install O-ring on drive shaft prior to installation of the generator into the aircraft.

For shipment or storage, seal starter-generator unit in suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

For shipment, package the unit in its original shipping container if possible. Include applicable inspection, test, repair, and installation documents. Otherwise, package-seal unit in accordance with best commercial practices. Refer to STORAGE section in this manual for packing materials.

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FITS AND CLEARANCES

1. Introduction

A. The following paragraphs provide information for determining the acceptability of fits and clearances of the starter-generator.

B. Examine the parts for damage. Refer to CHECK section, for details.

C. Repair the parts before assembly. Refer to REPAIR section, for details.

D. The required torque values to be used during repair and assembly of starter-generator components and attaching parts are listed in Paragraph 2.

E. The acceptance limits for starter-generator components and subassemblies are listed in Paragraph 3.

2. Torque Values

Table 8001 gives information necessary to tighten fasteners to specified torque. Values shown do not include frictional torque caused by self-locking devices or rundown resistance. Frictional torque values must be added to the specified torque.

Nuts, bolts, and screws not listed in Table 8001 are to be tightened in accordance with Safran Power methods and techniques or practices acceptable to your administration as specified in FAR PART 43.

IPL Figure and Item Number	Item	Torque lbf.in (N•m)
10001-80	Screw	7.7 to 10.3 (0,87 to 1,16)
10001-110	Screw	22.7 to 35.0 (2,6 to 4,0)
10001-130	Nut	100 to 120 (11,3 to 13,6)
10001-220	Screw	18 to 24 (2,03 to 2,71)
10001-350	Screw	13.5 to 18.0 (1,5 to 2,0)
10001-380	Screw	18 to 24 (2,03 to 2,71)
10001-430	Screw	25 to 30 (2,83 to 3,39)
10001-610	Screw	28.0 to 37.6 (3,2 to 4,2)
10001-670	Nut (Part of Ring Clenching Clamp)	50 (5,65)

Table 8001 - Torque Values

3. Component Acceptance Limits

Refer to Table 8002 for acceptance limits applicable to starter-generator components and subassemblies. Paragraph designations in the CHECK column refer to applicable inspection procedures found in the CHECK section, except where noted.

NOTE: Unless otherwise specified, numbers in parentheses ( ) refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST.

CHECK section	Item Description	Inspect for…	Acceptance Limits
8.C.(4)	Spring (520)	Tension: Models 23032-010, 23032-011, 23032-018	Position A 1.95 lb (0,88 kg) min. Position B 2.75 lb (1,25 kg) max.
		Models 23032-025, 23032-026, 23032-027, 23032-028, 23032-042, 23032-043, 23032-044, 23032-048, 23032-049	Position A 2.40 lb (1,01 kg) min. Position B 3.30 lb (1,50 kg) max.
		Models 23032-045, 23032-046, 23032-047, 23032-051, 23032-052, 23032-054, 23032-062	Position A 1.75 lb (0,79 kg) min. Position B 2.50 lb (1,13 kg) max.
8.D.(2)	Fan assembly (200) Only for two-part fans	Protrusion beyond locating shoulder of fan hub (all two-part fans)	0.060 inch (1,52 mm) minimum
		Back of blade distance from locating shoulder of fan hub: Fan P/N 23032-1303	0.780 inch (19,81 mm) maximum
		Fan P/N 23032-1301	0.820 inch (20,83mm) maximum
8.E.(5)	Drive shaft (120)	Drive end spline dia. over two 0.1094 inch (2,78 mm) dia. pins: All models	0.757 inch (19,23 mm) minimum
		Armature mating spline dia. over two 0.0600 inch (1,524 mm) dia pins. All models.	0.4269 inch (10,843 mm) minimum
8.F.(3)	Friction ring (180)	Thickness	0.060 inch (1,52 mm) minimum

Table 8002 - Acceptance Limits

CHECK section	Item Description	Inspect for…	Acceptance Limits
8.G.(5)	Dampener plate (170)	Thickness	0.038 inch (0,97 mm) minimum
		Internal spline dia. over two 0.090 inch (2,29 mm) dia. pins	0.655 inch (16,637 mm) maximum
8.I.(5)	End bell - drive-end (210 and 260)	Bearing liner diameter for P/Ns: 23032-1402 23032-1575 23032-2101 23032-2100 23032-3651	1.5745 inch (39,992 mm) minimum 1.5748 inch (40,000 mm) maximum See Figure 8001.
		Bearing liner diameter for P/Ns: 23032-1202 23032-1203	1.5747 inch (39,997 mm) minimum 1.5750 inch (40,005 mm) maximum See Figure 8001.
8.K.(2)	Armature (330)	Commutator bar-to-bar concentricity acceptance test values	Bar to Bar: 0.0002 inch (0,005 mm) max. T.I.R.: 0.0007 inch (0,015 mm) max.
		Commutator bar-to-bar (Before refinishing)	Bar to Bar: 0.0008 inch (0,020 mm) max
8.K.(7)	Armature (330)	Bearing journal outer diameter (both ends)	0.6691 to 0.6694 inch (16,995 to 17,003 mm)
8.K.(8)	Armature (330)	Commutator diameter	Not less than 2.030 inch (51,56 mm)
8.K.(10)	Armature (330)	Mica undercut (before recut)	Depth: Less than 0.025 inch (0,64 mm) Width: 0.029 to 0.035 inch (0,74 to 0,89 mm)
		Mica undercut (after recut)	Depth: 0.025 to 0.045 inch (0,64 to 1,14 mm) Width: 0.029 to 0.035 inch (0,74 to 0,89 mm)

Table 8002 - Acceptance Limits (Continued)

CHECK section	Item Description	Inspect for…	Acceptance Limits
8.K.(12)	Armature (330)	Commutator bar-to-bar concentricity after refinishing	Bar to Bar: 0.0001 inch (0,0025 mm) max. T.I.R.: 0.0005 inch (0,0127 mm) max.
8.O.	Filter board assembly (450)	Capacitance value for P/Ns 23032-1660 23032-1662	0.0176 to 0.0264 µF
		Capacitance value for P/N 23081-350	0.297 to 0.363 µF
8.M.	Stator and housing assembly (550) terminal block (600)	Capacitance values: B to E B to ground C to ground	1.6 to 3.0 µF Tested @ 110 to 130 Hz, 77° F (25° C) ± 10% 0.018 to 0.033 µF Tested @ 900 to 1100 Hz, 77° F (25° C) ± 10% 1.6 to 3.0 µF Tested @ 110 to 130 Hz, 77° F (25° C) ± 10%
8.N.(6)	End bell, anti-drive (540)	Bearing liner diameter for P/Ns: 23032-2163 23032-2162 23032-2167 23032-3660 23081-3365 23081-3320 23081-3322	1.5747 inch (39,997 mm) minimum 1.5750 inch (40,005 mm) maximum. See Figure 8001

Table 8002 - Acceptance Limits (Continued)

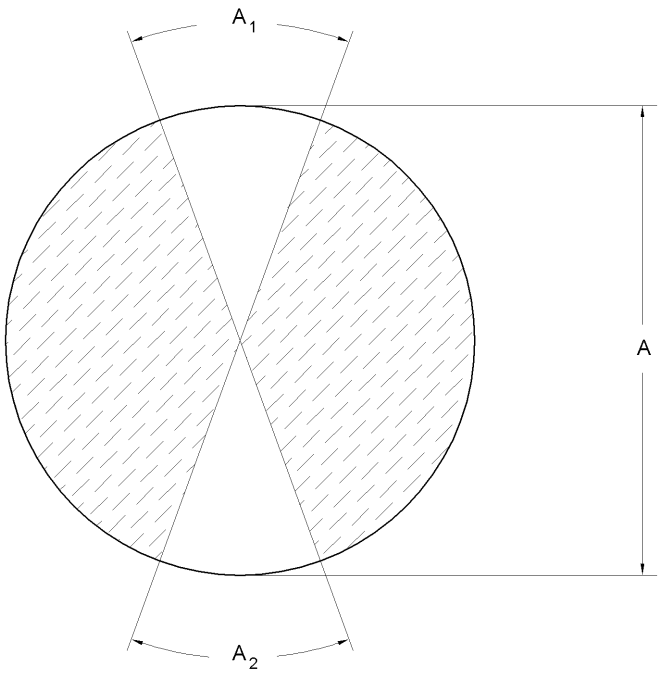


Figure 8001 - Measuring Bearing Liner Diameters

NOTE: During overhaul/service inspection, diameter of bearing liner is considered to be acceptable if up to 25% of the circumference is 0.0001 inch (0,0025 mm) above the maximum diameter limit in the FITS AND CLEARANCES section.

NOTE: This criteria does not apply to new or repaired bearing liners.

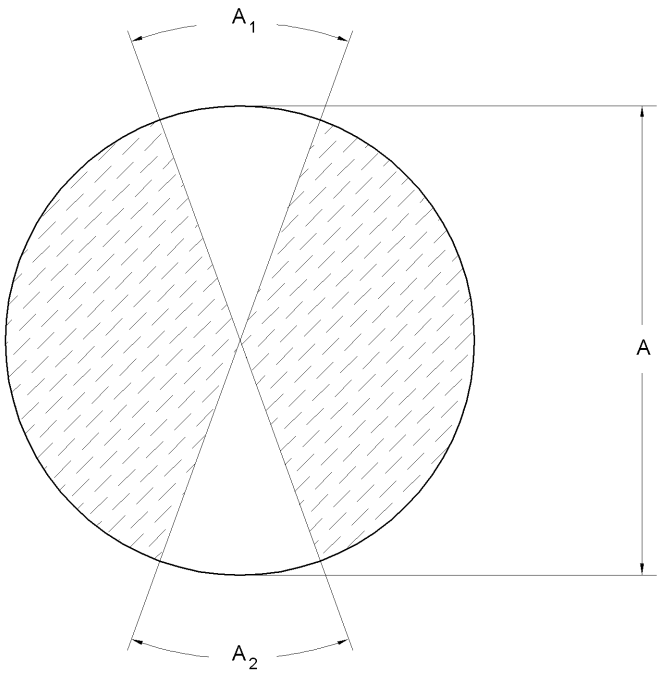


Figure 8002 - Measuring Armature Bearing Journal Diameters

NOTE: During overhaul/service inspection, diameter of bearing journal is considered to be acceptable if up to 25% of the circumference is 0.0001 inch (0,0025 mm) below the minimum diameter limit in the FITS AND CLEARANCES section.

NOTE: This criteria does not apply to new or repaired journals.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Introduction

Table 9001 lists the approved items for use during overhaul of the 23032 Series of DC Starter-Generators.

Figure	Nomenclature	Application
Figure 9001	Bearing hub support	To support drive and anti-drive bearing supports while pressing bearings into and out of end bells.
Figure 9002	Outer race bearing driver	To press anti-drive end bearing into anti-drive end bell.
Figure 9003	Inner race bearing driver	To press bearings onto armature shaft and anti-drive end bearing out of anti-drive end bell.
Figure 9004	Armature assembly support - vertical	To support armature for installation of bearings.
Figure 9005	Armature shaft adapter - drive end	To remove dampener backplate and bearing from armature shaft.
Figure 9006	Dampener plate driver	To install dampener plate onto dampener hub.
Figure 9007	Spline wrench	To hold drive shaft while removing or installing fan nut.
Figure 9008	Stator and housing assembly support - horizontal	To support stator and housing assembly in a horizontal position as required
Figure 9009	Stator and housing assembly support - vertical	To support stator and housing assembly in a vertical position as required.
Figure 9010	End bell assembly support - anti-drive end	To press armature out of anti-drive end bearing.
Figure 9011	Commutator turning fixture	To support armature in lathe to turn commutator.
Figure 9012	Armature shaft adapter - anti-drive end	To drive armature out of anti-drive end end bell
Figure 9013	Commutation viewing adapter	To view the brushes
Figure 9014	Dampener Plate Gauge	To check the splines of the dampener plate

Table 9001 - Special Tools, Fixtures and Equipment

2. Tool Fabrication Instructions

The following pages identify required materials and fabrication instructions for each tool listed in Table 9001. Where dimensions and related data are given, the tool or fixture is approved for local manufacture.

A. Bearing Hub Support (Figure 9001)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0’. Machined ends to be parallel within 0.001 inch (0.025 mm) and square with sidewalls ± 0.05 degree. Material is AISI 1040 Steel hardened to Rc 35-40.

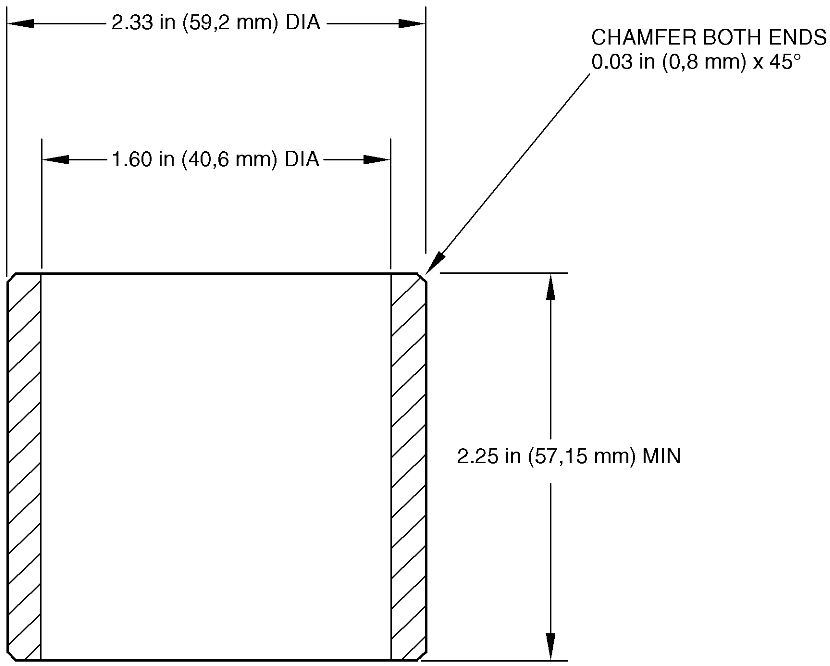


Figure 9001 - Bearing Hub Support

B. Outer Race Bearing Driver (Figure 9002)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0’. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is AISI 1040 Steel hardened to Rc 35-40.

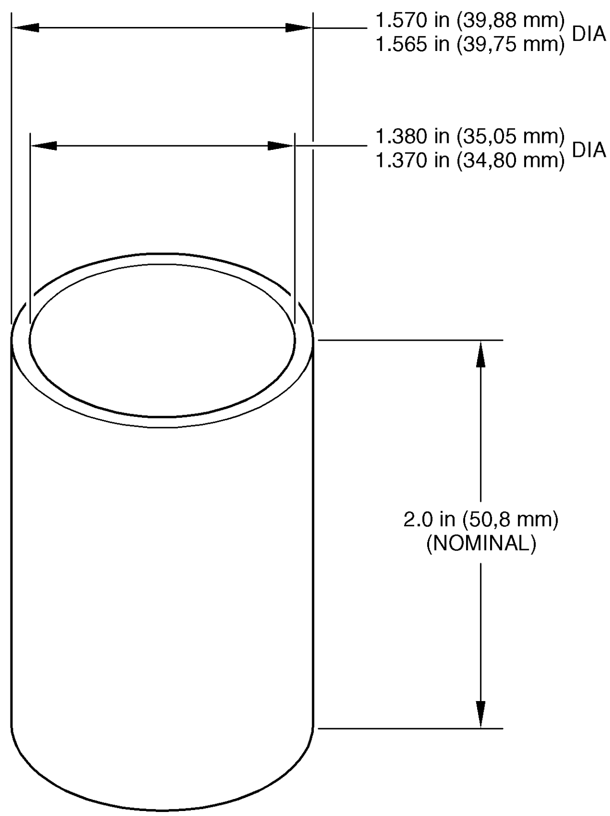


Figure 9002 - Outer Race Bearing Driver

C. Inner Race Bearing Driver (Figure 9003)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0'. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is AISI 1040 Steel hardened to Rc 35-40.

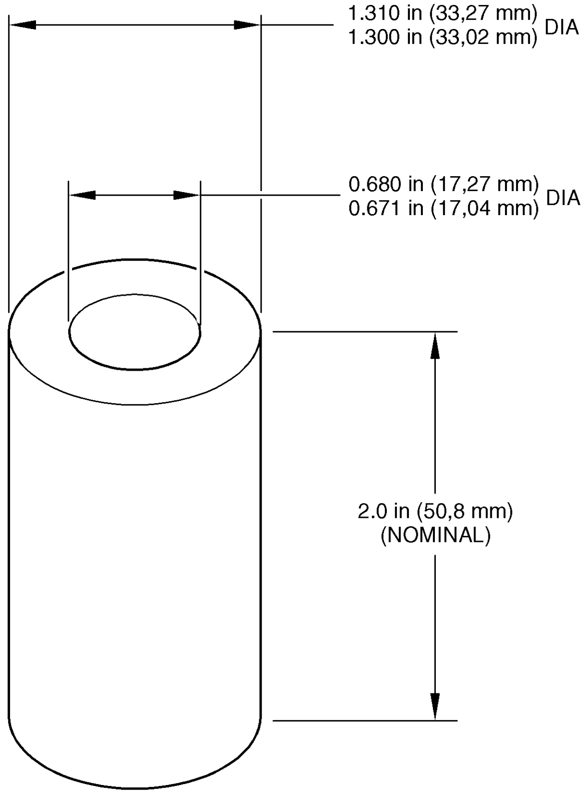


Figure 9003 - Inner Race Bearing Driver

D. Armature Assembly Support - Vertical (Figure 9005)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0'. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is AISI 1040 Steel hardened to Rc 35-40.

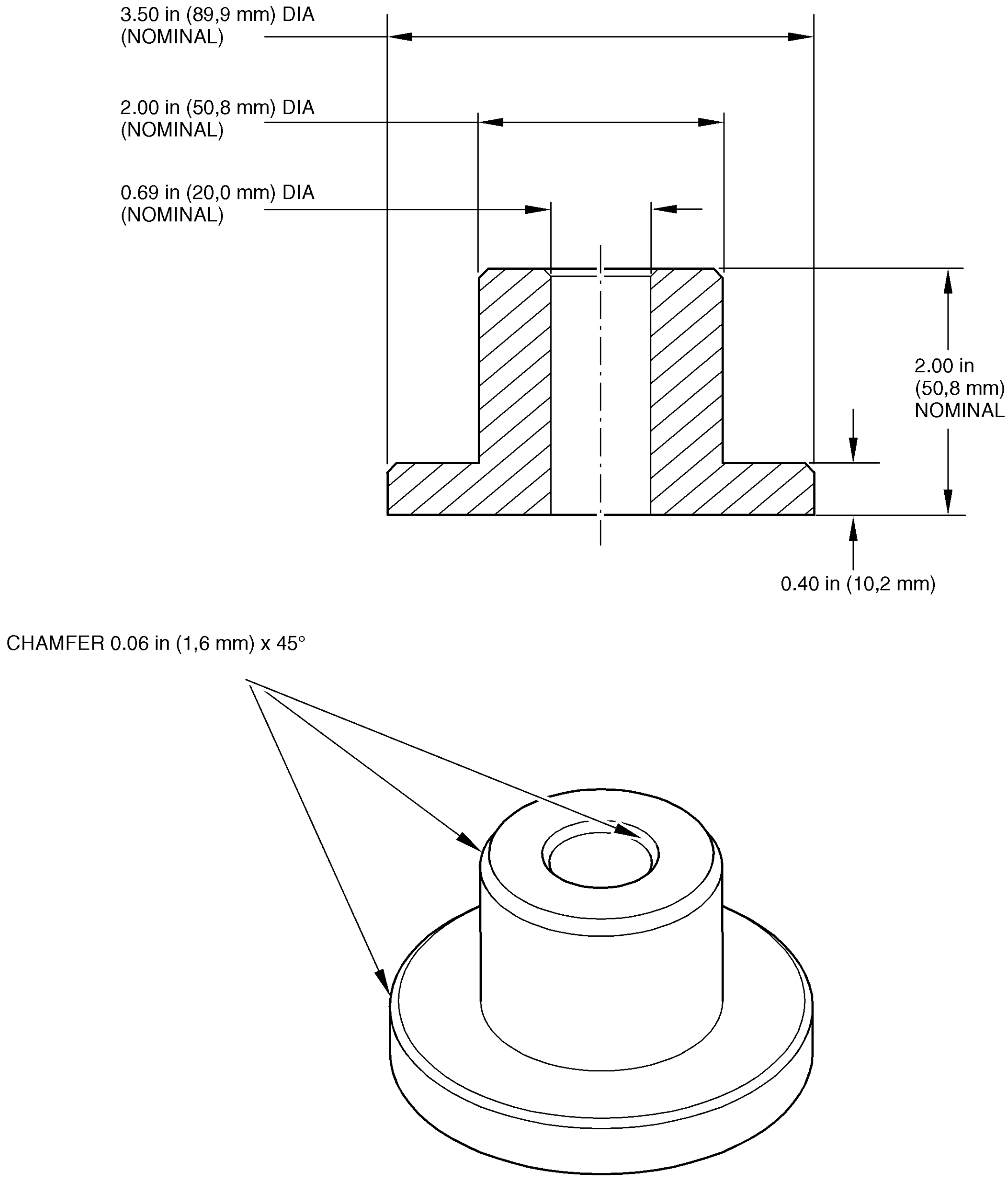


Figure 9004 - Armature Assembly Support - Vertical

E. Armature Shaft Adapter - Drive End (Figure 9005)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0'. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is brass.

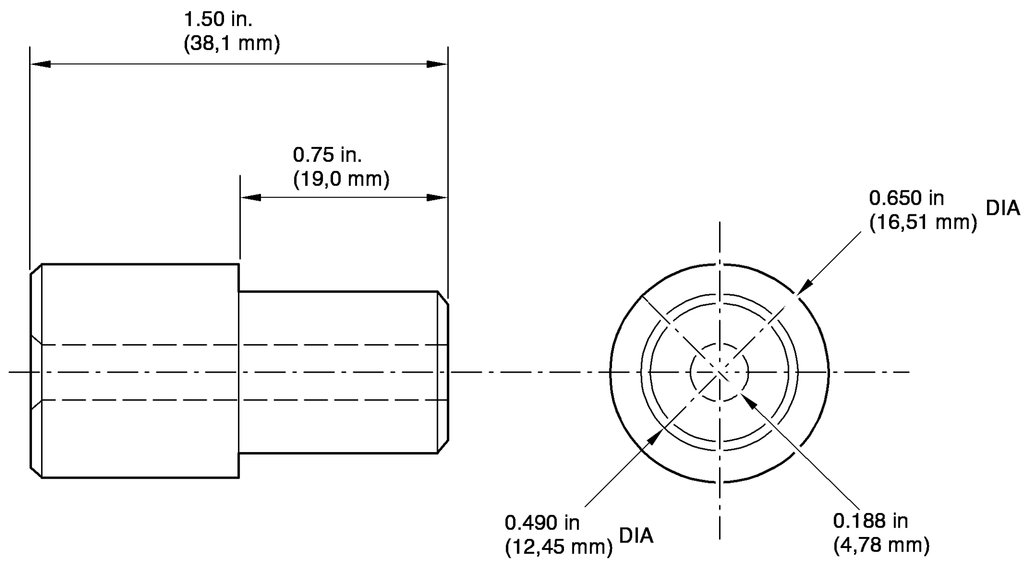


Figure 9005 - Armature Shaft Adapter - Drive End

F. Dampener Plate Driver (Figure 9006)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0’. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is AISI 1040 Steel hardened to Rc 35-40.

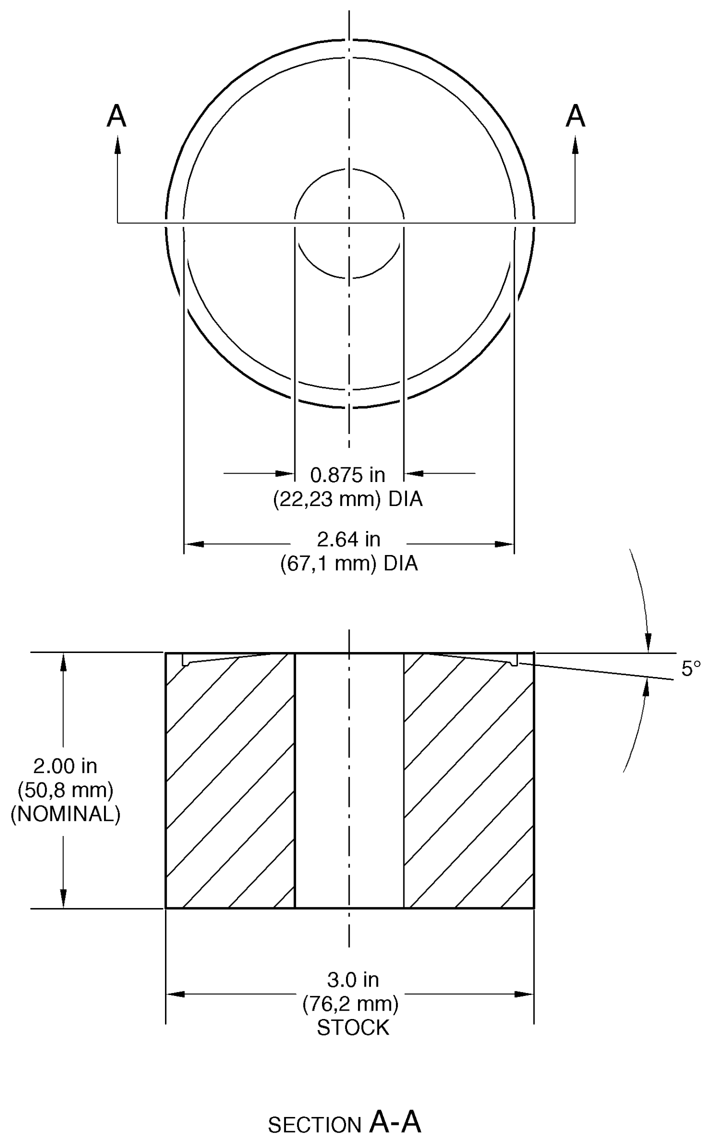
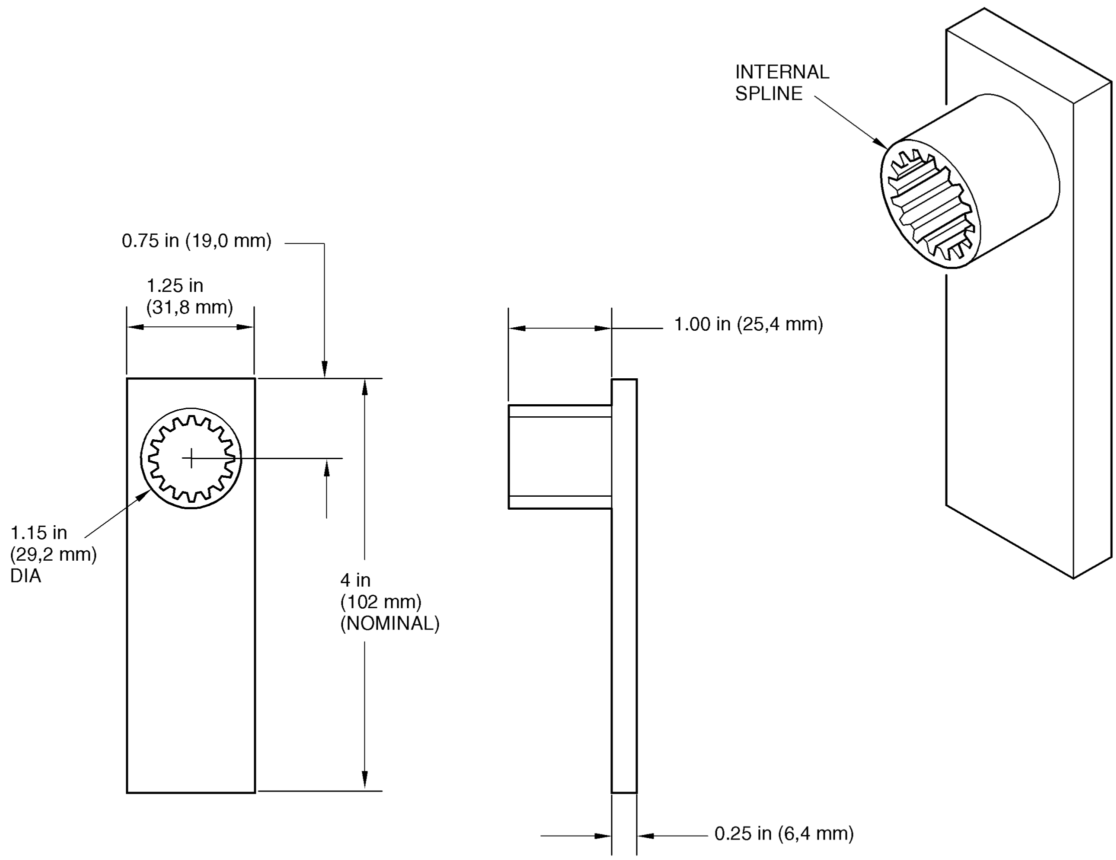


Figure 9006 - Dampener Plate Driver

G. Spline Wrench (Figure 9007)

Tolerances on decimals, 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Angles ± 2°0’. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is AISI 1040 Steel hardened to Rc 35-40.



12 TOOTH SPLINE

INTERNAL INVOLUTE SPLINE DATA FILLET ROOT SIDE FIT	INCH	MM
NUMBER OF TEETH	12	
DIAMETRAL PITCH	20/40	
PRESSURE ANGLE	30°	
PITCH DIAMETER	0.6000	15,240
MINOR DIAMETER (MIN)	0.5550	14,097
MAJOR DIAMETER (MIN)	0.6500	16,510
CHORD SPACE (MIN)	0.0730	1,853
PIN DIAMETER	0.0720	1,829
BETWEEN THREE 0.072 PINS (MIN)	0.5095	12,941

Figure 9007 - Spline Wrench

H. Stator and Housing Assembly Support - Horizontal (Figure 9008)

All dimensions are nominal. Material is any suitable hardwood.

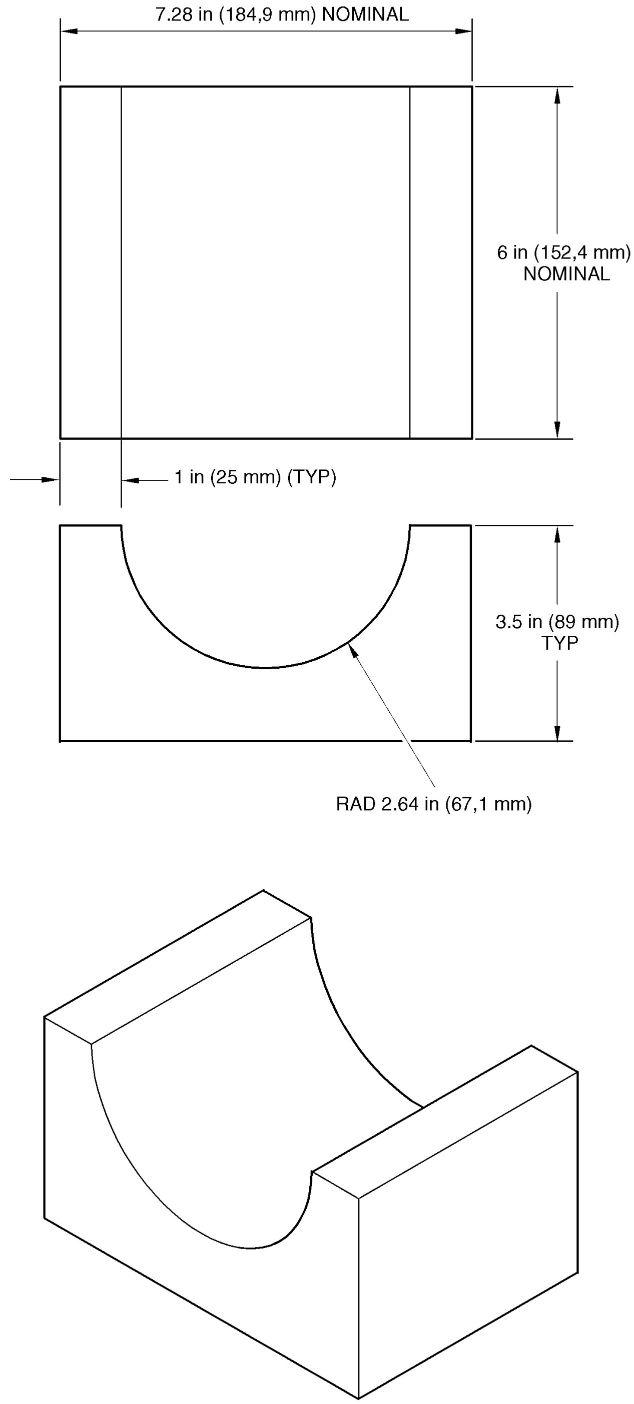


Figure 9008 - Stator and Housing Assembly Support - Horizontal

I. Stator and Housing Assembly Support - Vertical (Figure 9009)

All dimensions are nominal. Material is any suitable hardwood.

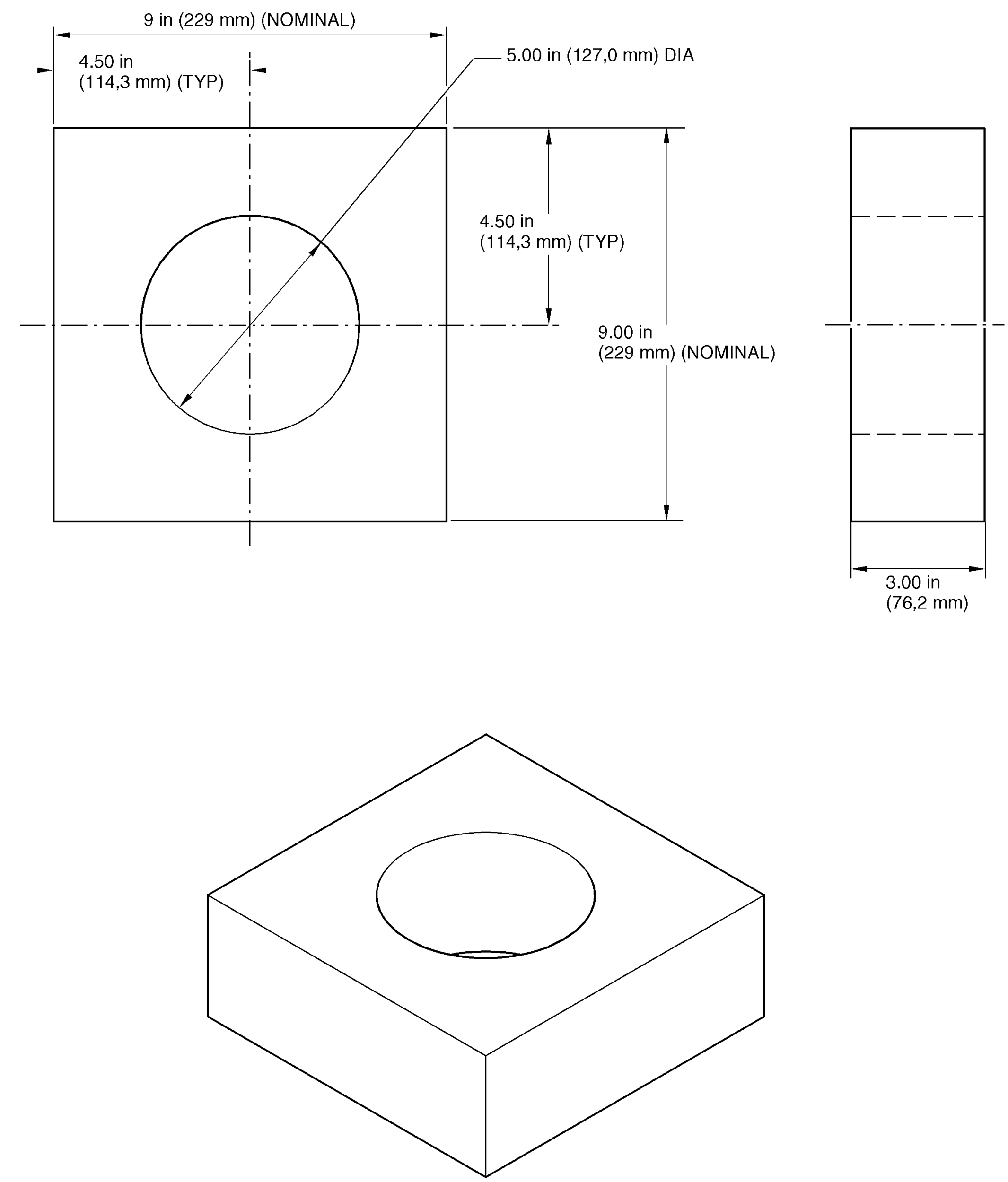


Figure 9009 - Stator and Housing Assembly Support - Vertical

J. End Bell Assembly Support, Anti-Drive End (Figure 9010)

Material:	01 tool steel or equivalent	
Stock Size:	6.0 inch diameter (152,4 mm)	
Tolerances on:	Decimals	0.XX ± 0.01 inch (0,25 mm) 0.XXX ± 0.005 inch (0,127 mm)
Angles:	± 5 Degrees	

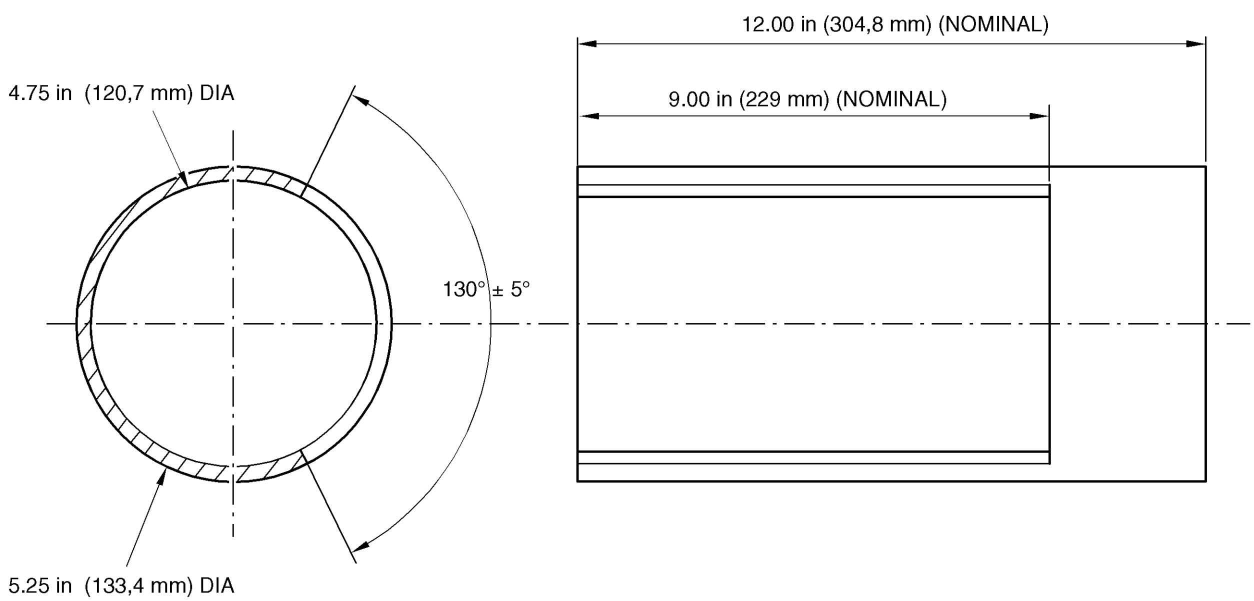


Figure 9010 - End Bell Assembly Support, Anti-Drive End

K. Commutator Turning Fixture (Figure 9011)

Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell C 35-40. Material is AISI 1040 Steel, stock size 2.50 in. (63,5 mm) diameter.

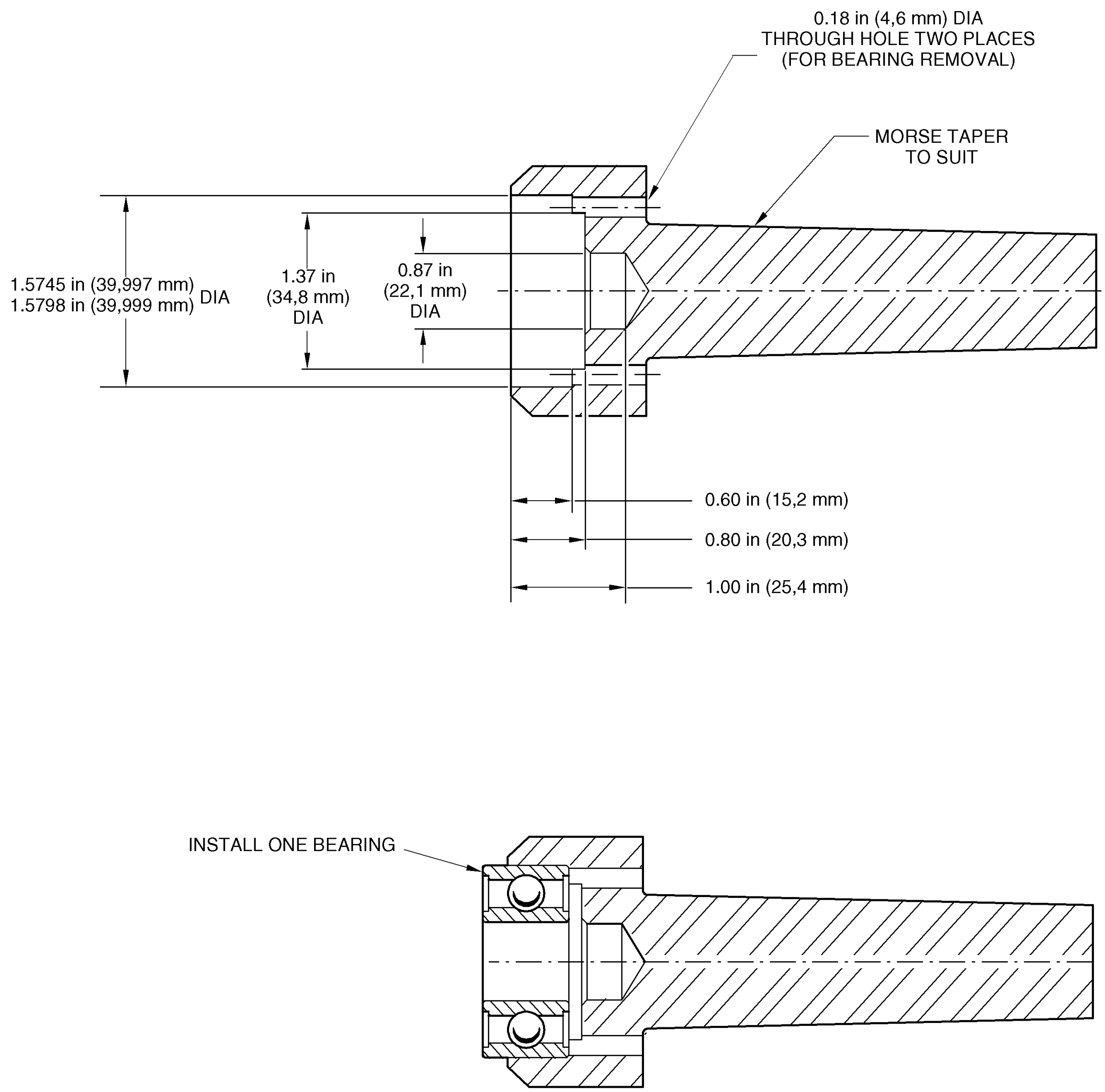


Figure 9011 - Commutator Turning Fixture

L. Armature Shaft Adapter - Anti-Drive End (Figure 9012)

Tolerances on decimals, 0.XX, ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127mm), Angles ± 2°0'. Machined ends to be parallel within 0.001 inch (0,025 mm) and square with sidewalls ± 0.05 degree. Material is brass.

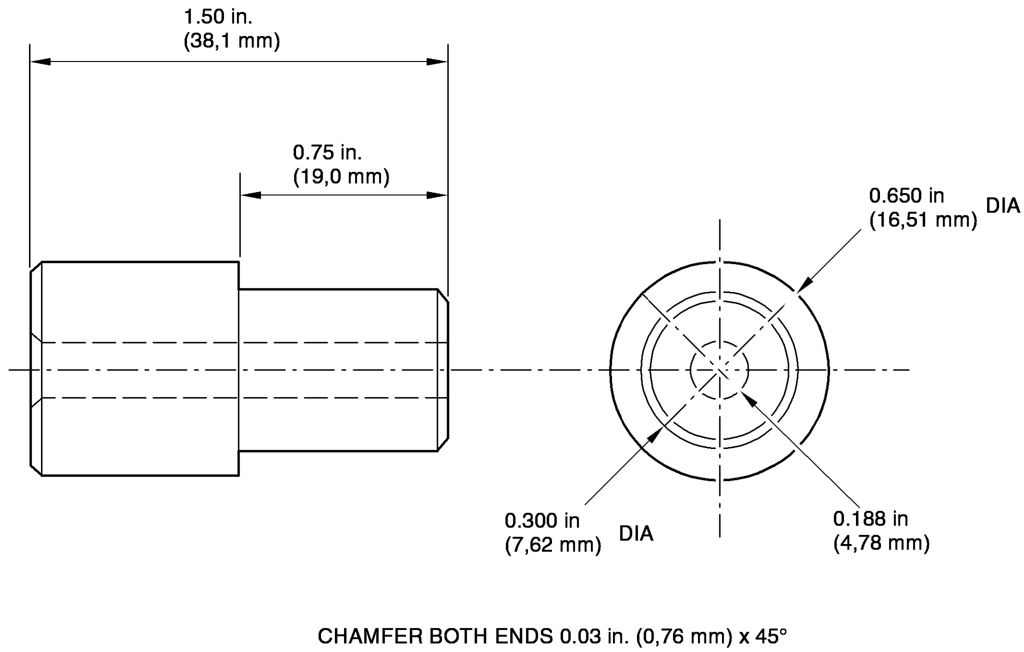


Figure 9012 - Armature Shaft Adapter - Anti-Drive End

M. Commutation Viewing Adapter. See Figure 9013

This adapter is constructed using an extra air inlet that fits the starter-generator, 0.125 in. (3,175 mm) thick, impact-resistant plexi-glass, and 16 pop rivets. Construction is as follows:

(1) Cut four holes in the air inlet. Each hole must be positioned above one of the four brush holder assemblies to allow for viewing the brushes as they make contact with the commutator during test.

(2) Cut four pieces of plexi-glass to size to cover each hole in the air inlet.

(3) Attach the four pieces of plexi-glass to the viewing windows on the outer surface of the viewing adapter using four pop rivets at each location

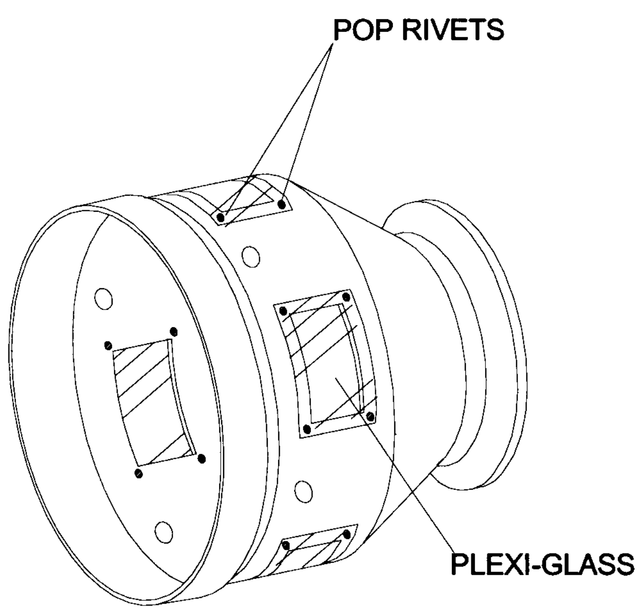
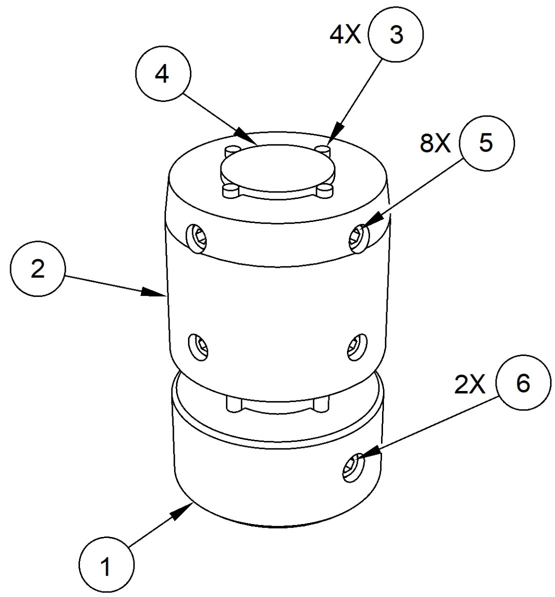


Figure 9013 - Commutation Viewing Adapter

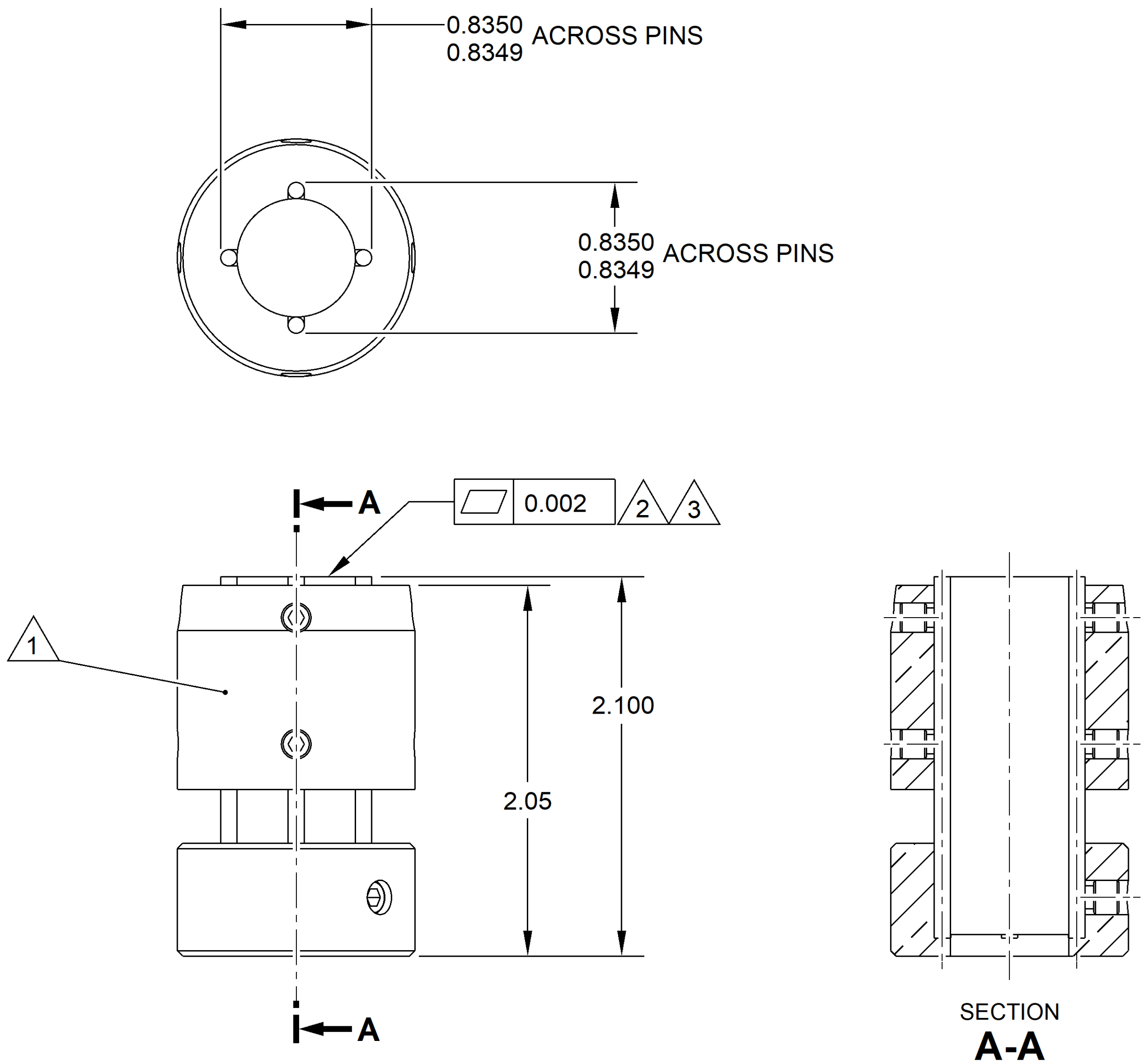
N. Dampener Plate Gauge Tool. See Figure 9014.

NOTE: To check the splines of the dampener plate - Reference CHECK section.



ITEM	PART	MATERIAL	QTY.
1	BOTTOM COLLAR, KNURLED	W1 TOOL STEEL OR O1 TOOL STEEL	1
2	TOP COLLAR	W1 TOOL STEEL OR O1 TOOL STEEL	1
3	CLASS X GAUGE PIN, Ø 0.0900 X 2.00 LENGTH	TOOL STEEL	4
4	CLASS X GAUGE PIN, Ø 0.6550 X 2.00 LENGTH	TOOL STEEL	1
5	#8-32 UNC-3A X 3/16 SET SCREW	STEEL	8
6	#10-24 UNC-3A X 3/16 SET SCREW	STEEL	2

Figure 9014 - Dampener Plate Gauge (P/N 19-601076) (Sheet 1 of 4)



NOTES:

1. MARK TOOL WITH PART NUMBER 19-601076 APPROXIMATELY WHERE SHOWN.
2. WHEN ASSEMBLED, FACES OF ITEMS (4) AND ITEM (3) SHALL MEET REQUIREMENT.
3. DIAMOND KNURL FINISH ITEM (1) ON SURFACE INDICATED.

Figure 9014 - Dampener Plate Gauge (P/N 19-601076) (Sheet 2 of 4)

BOTTOM COLLAR, KNURLED

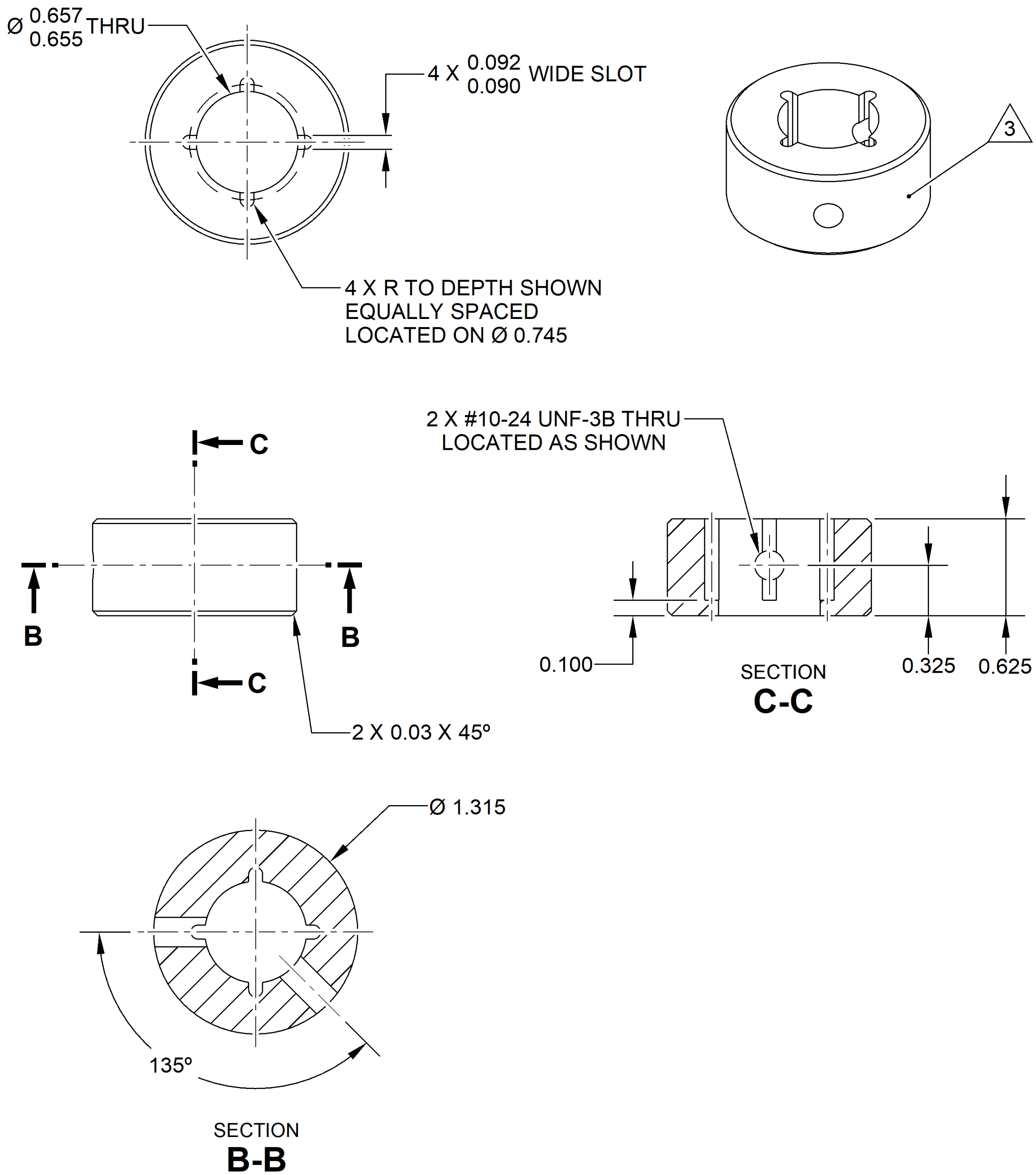


Figure 9014 - Dampener Plate Gauge (P/N 19-601076) (Sheet 3 of 4)

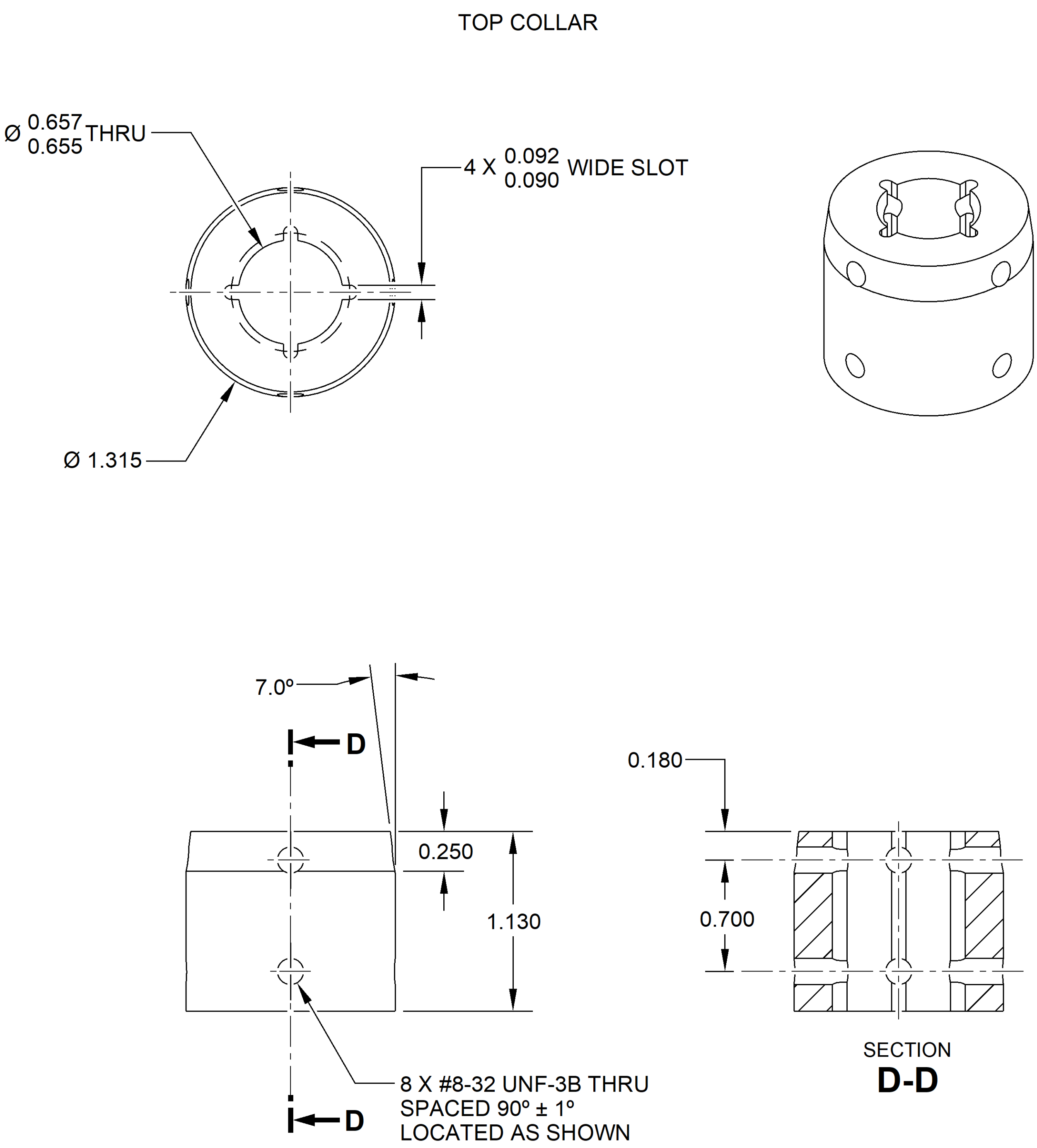


Figure 9014 - Dampener Plate Gauge (P/N 19-601076) (Sheet 4 of 4)

SPECIAL PROCEDURES

1. Introduction

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REMOVAL

1. Introduction

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INSTALLATION

1. Introduction

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SERVICING

1. Introduction

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STORAGE

1. Introduction

Materials recommended for packaging rotating machines containing grease-lubricated bearings for storage or shipment are listed below in Table 15001.

Description	Specification	Quantity
Tag	Commercially available	1 (domestic) 2 (overseas)
Grease	MIL-G-81322	AR
Chemically Neutral Protective Paper,	Commercially available	AR
Polyethylene (Plastic) Wrap	Commercially available	AR
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam (Safran Power recommended method: 3 inch (76 mm) thick minimum expanded foam surrounding machine on all sides)	Commercially available	AR
Small plastic bag	Commercially available	AR
O-Ring (for applicable models)	Check Illustrated Parts List for current p/n	1 each
Cardboard tubing	Commercially available	AR
Tape - waterproof, pressure sensitive	Commercially available	AR
Original shipping box or alternate	PPP-B-636 (or equivalent)	1 each
Box - WC5 overseas shipping container	PPP-B-636 (or equivalent)	1 each

Table 15001 - Packaging Material

A. General Information

CAUTION: IF MACHINE STORAGE TIME IS MORE THAN 24 MONTHS WITH NO USE, IT IS RECOMMENDED THAT ITS BEARINGS BE REPLACED. IT MUST THEN BE RE-TESTED ACCORDING TO TESTING AND FAULT ISOLATION SECTION BEFORE BEING PLACED INTO SERVICE.

(1) Unit must have successfully completed tests specified in TESTING AND FAULT ISOLATION section of this manual before preparing unit for shipment or storage.

(2) Record following information to tag(s).

- Model Number
- Serial Number

- Mod Status
- Test Date (PASSED)
- Packing date

(3) Use packaging materials as specified in Table 15001.

B. Documentation

Include all applicable documentation with unit:

- Testing Records
- Repair Reports
- Final Inspection/Check Records
- Packing List & Certificate of Conformance

C. Domestic Packaging

(1) If machine includes drive shaft with O-ring/oil sealing provision, place O-ring into a small plastic bag, include instructions to lubricate and install the O-ring on drive end of shaft prior to installation on aircraft, seal bag, and attach it to the machine.

(2) Apply lubricating grease to drive spline according to MIL-G-81322 and wrap it in protective paper according to MIL-B-121A, Grade A, Type II.

(3) Place unit and desiccant into a waterproof and vapor-proof heat-seal bag and partially heat-seal it while forcing as much air as possible from bag.

(4) Insert vacuum tube into bag to draw remaining air out of bag.

(5) Withdraw vacuum tube quickly and complete heat-sealing of bag.

(6) Using machine's original shipping container if possible, place bagged machine into box surrounded with a minimum of 3 inch (76 mm) thick shock absorbing, cushioning material on all six sides.

(7) Securely and completely seal all flapped openings of box with tape.

(8) Tape tag to exterior surface of box. Make sure all information is visible.

D. Overseas Shipment on Surface Vessels

(1) Accomplish domestic packaging of machine in accordance with Paragraph 1.C.

(2) Place domestically packaged generator or starter-generator into WC5 shipping container.

(3) Securely and completely, seal all flapped openings of shipping container with tape.

(4) Tape tag to exterior surface of shipping container. Make sure all information is visible.

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REWORK

1. Introduction

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ILLUSTRATED PARTS LIST

1. Introduction

A. General

(1) This section provides a listing of assemblies and detail parts for the 23032 Series of DC Starter-Generators. All parts are listed, except for parts which lose their identities by being permanently fastened to other parts or are part of an assembly not subject to disassembly. Each list is arranged in disassembly sequence, except that attaching parts are listed immediately after the parts they attach, under the heading of (ATTACHING PARTS).

(2) All replacement parts are manufactured or source-controlled by Safran Power with the exception of those parts given an MS, AN, NAS, ANSI, ASME or ISO, etc. part number. (See Paragraph 2.B. below).

CAUTION: ANY USE OF PARTS, MATERIALS OR PROCEDURES NOT AUTHORIZED BY SAFRAN POWER FOR MAINTENANCE OR OVERHAUL OF UNIT(S) CAN AFFECT CONTINUED AIRWORTHINESS OR INVALIDATE CERTIFICATION.

To order authorized Safran Power parts, contact your regional Safran Power Customer Service Center.

(3) The Illustrated Parts List (IPL) is divided into the parts that follow:

- Vendor List (when applicable)
- Numerical List (when applicable)
- Detailed Parts List

B. Vendor List (when applicable)

(1) The Vendor List is included in the IPL when parts are not supplied by Safran Power.

(2) The list gives all supplier codes used in this manual and the names and addresses of the suppliers.

C. Numerical Index (when applicable)

(1) A Numerical Index is included when there are more than five pages of Detailed Parts List.

(2) The Numerical Index gives, in alpha-numerical sequence, all part numbers given in the Detailed Parts List. An Airline Stock Number column is given for airline use. The Total Req'd column gives the total quantity required for each part number at the figure and item entry.

D. Detailed Parts List

(1) The Detailed Parts List includes parts lists and related illustrations.

(2) Each list is in disassembly sequence but that attaching parts are given immediately after the parts they attach. These are headed (ATTACHING PARTS).

(3) More data on the Detailed Parts List is given in Paragraph 2.

2. Arrangement of Parts List

A. Figure and Item Number

The figure number indicates the figure where the part is illustrated. Each item number corresponds to a part illustrated in the applicable figure. Several item numbers may have a letter following a number (e.g. 10 A). This indicates that the part has the same function and location as the base number (e.g. 10), but can be different in form and material. An item number that is preceded by a dash (e.g. -30) is not illustrated in the applicable figure.

B. Part Number

The part numbers listed in this column are the only authorized parts for replacement and overhaul of the starter-generator. The list consists mainly of Safran Power part numbers but does include Military Standard (MS), Army Navy (AN), National Aerospace Standard (NAS) and industry standard (ANSI, ASME, ISO, etc.) part numbers.

C. Nomenclature

The proper name and type of each part is provided in this column. The description of each item is indented by columns to indicate the relationship to the next higher assembly (NHA). The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

1 2 3 4 5
Assembly or Installation Descriptive Title
. Assembly
. Attaching Parts for Assembly
. . Detail Parts for Assembly
. . . Subassembly
. . . Attaching Parts for Subassembly
. . . . Detail Parts for Subassembly

The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. A list of the terms used to show interchangeability and their definition is as follows:

Term	Parts List Abbreviation	Definition
Alternate	ALT	One of the two part numbers can be used. If the part number in the Nomenclature column is NOT specified as 'ALT', it can not be used as an alternative. The information is for reference only or as a way to help identify the part.
Modification	MOD	Modification (Mod) status details information about the effectivity of parts in regard to upgrades and modifications. Alpha variants (A through Y) (except I O Q S X and Z) are assigned to existing model numbers when necessary. Includes details of SB applicability.
Superseded	SUPSD BY	Part number listed is obsolete and must be replaced by new part listed at the next overhaul or repair. The superseded part is not to be installed or reinstalled.
Supersedes	SUPSDS	The part number listed must replace the obsolete part number at the next overhaul or repair.
Replaced by	REPLD BY	Part number listed is discontinued and should be replaced by the new part number. The original part may be used until current stock is depleted and then must be replaced by the new part listed.
Replaces	REPLS	The part listed replaces and is interchangeable with the item number shown in the notation.
Attaching Parts		Will be listed in the same column as the assembly they attach and the listing of parts will be followed by ---------- * ---------- in the same column.

D. Effect Code

This column establishes part relationships with starter-generator models, which are essentially the same, but have minor variations. These starter-generator models are the end items on the detailed parts list and are assigned reference letters such as A, B, C, D, etc. Subassemblies or detail parts, which are not common to all configurations, but are associated with one or more of the coded end items, carry the letter or letters assigned to the end item(s) with which they are associated. When parts are used on all models, the column is left blank. Effectivity codes are redefined for each major subassembly figure.

E. Units Per Assembly

The numbers listed in this column indicate the quantity of parts used per assembly at the location shown and are not necessarily the total quantity per unit. For bulk items, the abbreviation AR is used to indicate the part quantity is “as required”. The abbreviation NP indicates non-procurable and refers to items which are not procurable and may not be ordered. The abbreviation RF indicates that the item is listed for reference only.

3. Vendors List

In the case of an item supplied by a vendor and not listed under the prime manufacturer's part number, a vendor CAGE code is prefixed by the capital letter V appearing in the nomenclature column. This CAGE code number designates the original manufacturer of non-Safran Power components, and is in accordance with Cataloging Hand Books H4-1, H4-2, and H4-3. CAGE codes are listed in the NOMENCLATURE column, except for the government codes below, which are not listed:

V80205	National Aircraft Standard (prefix NAS)
V81349	Military Specifications (prefix M)
V88044	Army/Navy Standard (prefix AN)
V96906	Military Standard (prefix MS)

The Customer Support division in your region is to be contacted for parts dispatch.

4. Numerical Index

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
AN3-11A		10001-	-430A	8
AN500A10-12		10001-	610	2
AN500A8-8		10001-	350	4
AN503-8-10		10001-	-220A	8
AN503-8-16		10001-	-380A	8
AN935-10L		10001-	620	2
AN935-8L		10001-	230	8
		10001-	390	8
		10001-	360	4
AN960-10L		10001-	630	2
		10001-	490	16
AN960-416		10001-	-140A	1
AN960-416L		10001-	140	1
AN960-4L		10001-	290	4
AN960C10		10001-	570	2
AN960-C10L		10001-	-630A	2
AN960C616		10001-	590	3
JH12922		10001-	530	4
M83248/1-113		10001-	-150A	1
MS16624-1066		10001-	-300A	1
MS16995-30		10001-	-380B	8
MS20364-1032C		10001-	510	8
MS21042-3		10001-	560	2
		10001-	-510A	8
MS21042-4		10001-	-130A	1
MS21042-6		10001-	580	3
MS21045-L3		10001-	-680	1
MS21318-13		10001-	-20A	4
		10001-	-50A	2
MS21318-14		10001-	280	4
		10001-	20	4
		10001-	50	2
MS29561-113		10001-	150	1
MS35265-45		10001-	-350A	4
MS35265-65		10001-	-610A	2
MS35333-38		10001-	-400	2
		10001-	-240	2
MS35338-42		10001-	-230A	8

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
MS35338-42		10001-	-390A	8
		10001-	-360A	4
MS35338-43		10001-	-620A	2
MS9013-17		10001-	300	1
NAS1149F0332P		10001-	-490A	16
NAS1149F0463P		10001-	-140B	1
02-2001-20		10001-	-440A	8
02-4107-01		10001-	130	1
02-4212-15		10001-	500	8
02-5600-05		10001-	180	RF
02-5600-13		10001-	-180A	1
03-6009-07		10001-	-320C	RF
03-6009-18		10001-	-320D	2
03-6009-19		10001-	-320A	RF
03-6009-23		10001-	-320B	2
05-340200		10001-	110	4
05-340201		10001-	-110A	4
05-341302		10001-	-220B	8
05-341303		10001-	220	8
05-341306		10001-	-380C	8
05-341310		10001-	380	8
05-346370		10001-	80	4
05-346371		10001-	-80A	4
05-346560		10001-	-430B	8
05-346561		10001-	430	8
			-430C	8
05-370176		10001-	250	8
		10001-	410	8
05-370232		10001-	-410A	8
05-374094		10001-	470	4
		10001-	480	8
05-374095		10001-	-470A	8
05-631145		10001-	440	8
05-652009		10001-	-460	1
05-652013		10001-	640	1
05-652015		10001-	640B	1
		10001-	645	2
05-652918		10001-	640A	1
05-700105		10001-	-240A	2
05-700105		10001-	-400A	2

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
06-0017-09		10001-	40	1
06-0017-10		10001-	-40A	1
06-0017-17		10001-	-40B	1
06-0017-37		10001-	-40C	1
06-0017-40		10001-	-40D	1
06-0022-45		10001-	-40E	1
06-123301		10001-	-60	1
06-201020		10001-	30	1
06-209264		10001-	-10A	1
06-209285		10001-	-10B	1
06-209286		10001-	10	1
06-2300-11		10001-	-10C	1
07-111140		10001-	320	RF
23032-010		10001-	-1	RF
23032-011		10001-	-1A	RF
23032-018		10001-	-1B	RF
23032-025		10001-	-1C	RF
23032-026		10001-	-1D	RF
23032-027		10001-	-1E	RF
23032-028		10001-	-1F	RF
23032-042		10001-	-1G	RF
23032-043		10001-	-1H	RF
23032-044		10001-	-1J	RF
23032-045		10001-	-1K	RF
23032-046		10001-	-1L	RF
23032-047		10001-	-1M	RF
23032-048		10001-	-1N	RF
23032-049		10001-	-1P	RF
23032-051		10001-	-1Q	RF
23032-052		10001-	-1T	RF
23032-054		10001-	-1R	RF
23032-062		10001-	-1S	RF
23032-1143		10001-	310	2
23032-1202		10001-	-210C	1
23032-1203		10001-	-210B	1
23032-1230		10001-	340	1
23032-1280		10001-	190	RF
23032-1295		10001-	120	1
23032-1297		10001-	-120A	1
23032-1299		10001-	-120G	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23032-1301		10001-	200	RF
23032-1303		10001-	-200B	RF
23032-1331		10001-	70	1
23032-1334		10001-	-70A	1
23032-1336		10001-	-70C	1
23032-1380		10001-	100	4
23032-1392		10001-	-660A	1
23032-1402		10001-	-210A	1
23032-1423		10001-	-370	1
23032-1511		10001-	600	1
23032-1518		10001-	-600A	1
23032-1565		10001-	660	1
23032-1575		10001-	210	1
23032-1580		10001-	670	1
23032-1586		10001-	-670A	1
23032-1660		10001-	450	2
23032-1662		10001-	-450A	2
23032-1693		10001-	-120E	1
23032-1700		10001-	520	8
23032-1820		10001-	550	1
23032-1822		10001-	550B	1
23032-1823		10001-	-550A	1
23032-1825		10001-	-550C	1
23032-1828		10001-	-550E	1
23081-1130		10001-	-260C	1
23081-1855		10001-	-100D	4
23032-1900		10001-	160	1
23032-1910		10001-	170	1
23032-1920		10001-	330	1
23032-1922		10001-	-330B	1
23032-2010		10001-	-420	4
23032-2100		10001-	260	1
23032-2101		10001-	-260A	1
23032-2111		10001-	-330A	1
23032-2162		10001-	-540A	1
23032-2163		10001-	540	1
23032-2167		10001-	-540B	1
23032-2201		10001-	-660B	1
23032-2202		10001-	-660C	1
23032-2210		10001-	210D	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23032-2211		10001-	-210E	1
23032-2215		10001-	-210F	1
23032-2220		10001-	270	1
23032-2453		10001-	-660D	1
23032-2711		10001-	-190A	1
23032-2800		10001-	-690	1
23032-2842		10001-	-120C	1
23032-2843		10001-	120B	1
23032-2844		10001-	-120D	1
23032-2845		10001-	-120F	1
23032-2846		10001-	-120H	1
23032-2850		10001-	-120J	1
23032-2890		10001-	-70E	1
23032-2891		10001-	-70G	1
23032-340		10001-	-370C	1
23032-350		10001-	-550D	1
23032-3651		10001-	-260B	1
23032-3660		10001-	-540C	1
23032-3670		10001-	-70D	1
23032-3671		10001-	-70B	1
23032-500		10001-	650	1
23032-501		10001-	-650A	1
23032-505		10001-	-650B	1
23032-507		10001-	-650C	1
23033-1100		10001-	-420A	4
23033-1110		10001-	-530A	4
23033-1122		10001-	-520A	4
23033-1141		10001-	-100A	4
23033-302		10001-	-370A	1
23048-1481		10001-	-200A	1
23048-1483		10001-	-200C	1
23065-1771		10001-	-200D	RF
23065-1871		10001-	-200E	1
23065-1874		10001-	-200F	1
23081-1020		10001-	-420B	4
23081-1021		10001-	-420C	4
23081-1030		10001-	-530B	4
23081-1080		10001-	-340A	1
23081-1090		10001-	-70F	1
23081-1180		10001-	-520B	8

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23081-1710		10001-	-530C	4
23081-1803		10001-	-100C	4
23081-302		10001-	-370B	1
23081-303		10001-	-370D	1
23081-306		10001-	-370E	1
23081-309		10001-	-370F	1
23081-3320		10001-	-540E	1
23081-3322		10001-	-540F	1
23081-3365		10001-	-540D	1
23081-350		10001-	-450B	2
30059-1043		10001-	-470B	4
30300-1390		10001-	-100B	4
52-000096		10001-	Not shown	RF
52-000097		10001-	Not shown	RF

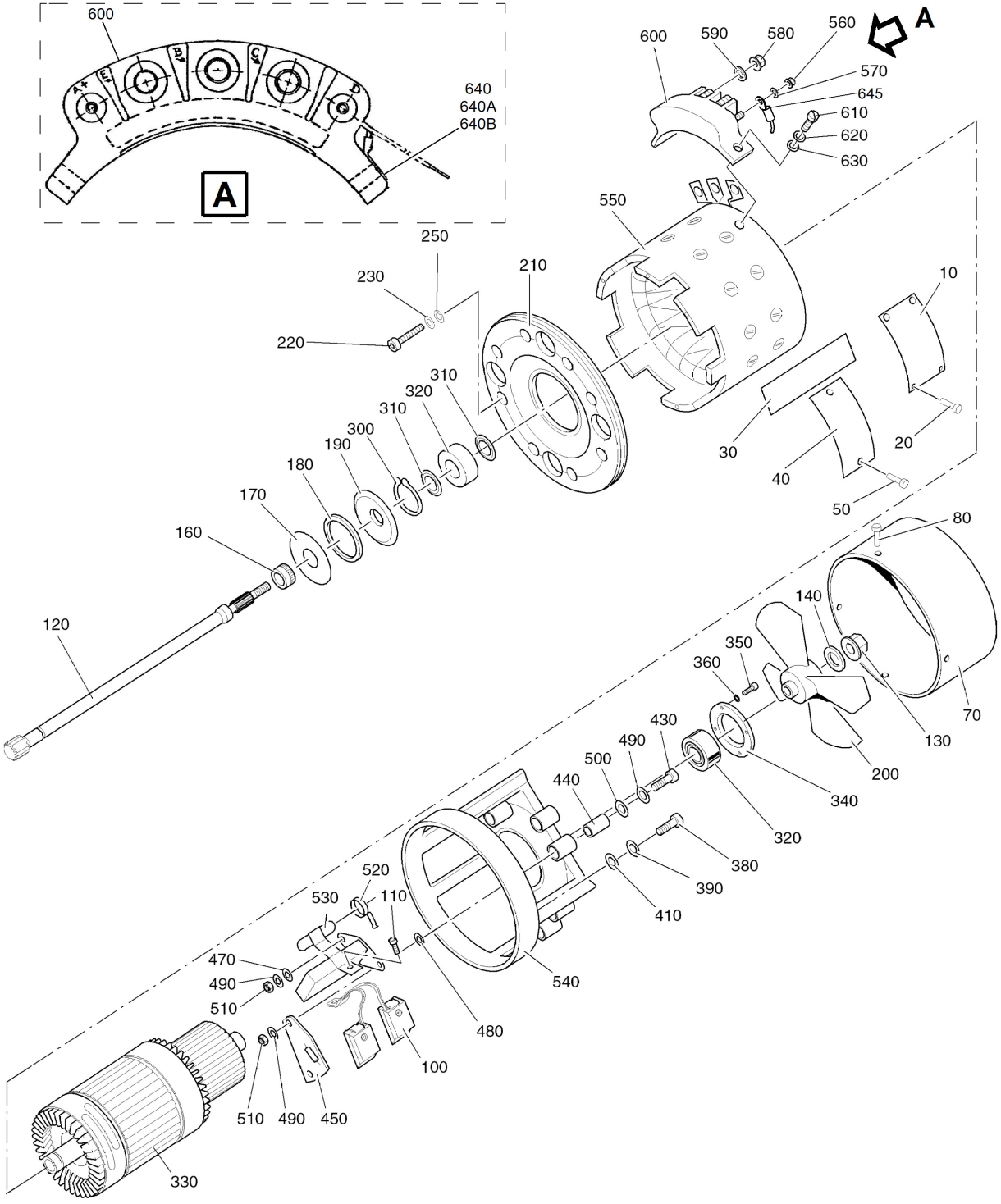

Figure 10001 - D.C. Starter-Generator (Sheet 1 of 2)

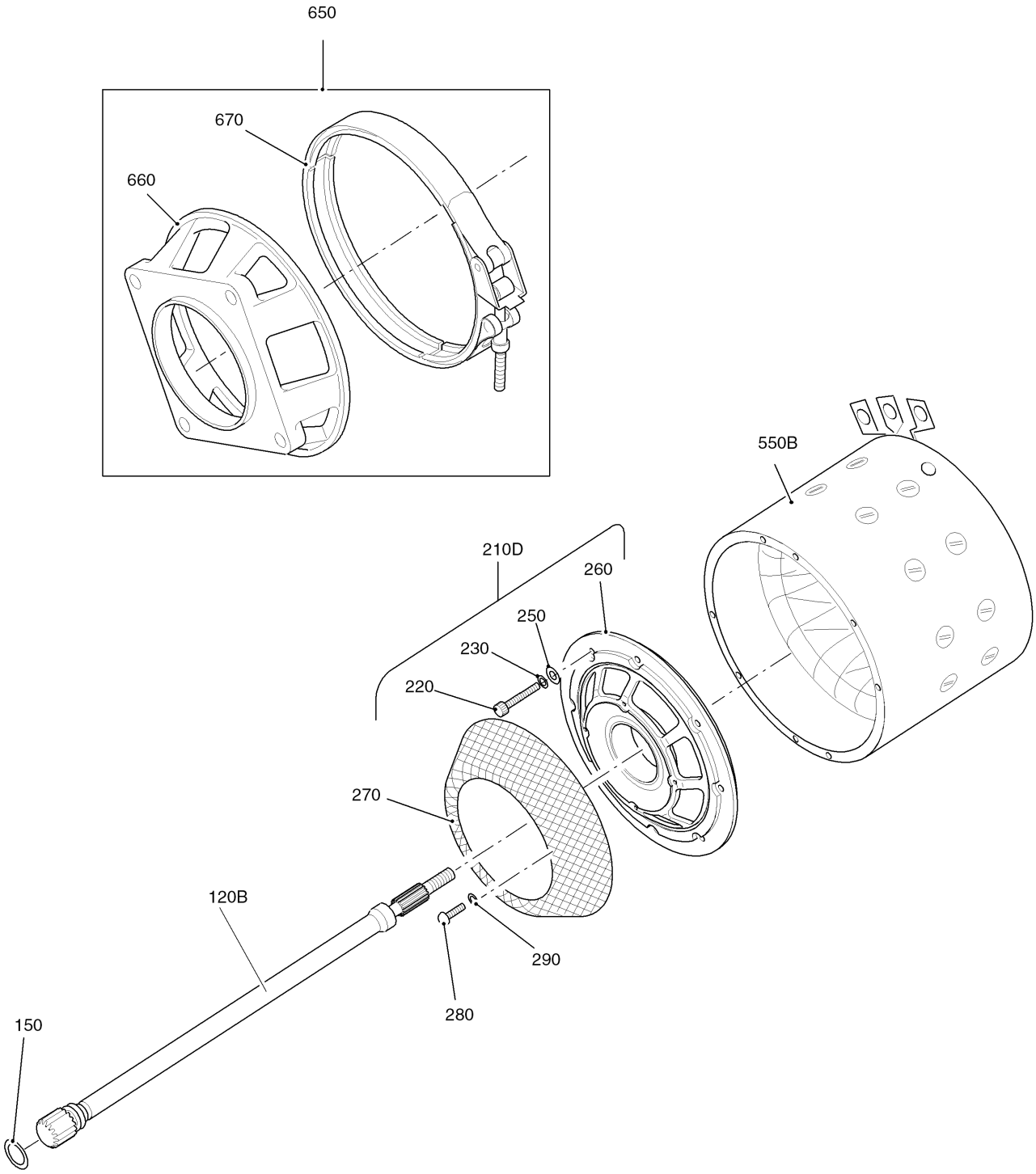

Figure 10001 - D.C. Starter-Generator (Sheet 2 of 2)

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-1	23032-010	STARTER-GENERATOR	A	RF
-1A	23032-011	STARTER-GENERATOR	B	RF
-1B	23032-018	STARTER-GENERATOR	G	RF
-1C	23032-025	STARTER-GENERATOR	I	RF
-1D	23032-026	STARTER-GENERATOR	J	RF
-1E	23032-027	STARTER-GENERATOR	K	RF
-1F	23032-028	STARTER-GENERATOR	L	RF
-1G	23032-042	STARTER-GENERATOR	M	RF
-1H	23032-043	STARTER-GENERATOR	N	RF
-1J	23032-044	STARTER-GENERATOR	P	RF
-1K	23032-045	STARTER-GENERATOR	R	RF
-1L	23032-046	STARTER-GENERATOR	S	RF
-1M	23032-047	STARTER-GENERATOR	T	RF
-1N	23032-048	STARTER-GENERATOR	U	RF
-1P	23032-049	STARTER-GENERATOR	V	RF
-1Q	23032-051	STARTER-GENERATOR	W	RF
-1R	23032-054	STARTER-GENERATOR	X	RF
-1S	23032-062	STARTER-GENERATOR	Y	RF
-1T	23032-052	STARTER-GENERATOR	Z	RF
10	06-209286	• PLATE, Identification, Replacement . . .	AB	1
-10A	06-209264	• PLATE, Identification, Replacement . . .	GUV	1
-10B	06-209285	• PLATE, Identification, Replacement . . .	IJKL MNPY	1
-10C	06-2300-11	• PLATE, Identification, Replacement . . .	RSTW XZ	1
		(ATTACHING PARTS)		
20	MS21318-14	• SCREW, Drive.	RSTWX Z	4
	MS21318-14	• SCREW, Drive, ... REPLD BY MS21318-13	ABIJK LUV	4
-20A	MS21318-13	• SCREW, Drive, ... REPLS MS21318-14	ABIJK LUV	4
	MS21318-13	• SCREW, Drive.	GMY	4
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- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
30	06-201020	• DECAL		1
40	06-0017-09	• PLATE, Information	J	1
-40A	06-0017-10	• PLATE, Information	L	1
-40B	06-0017-17	• PLATE, Information	NP	1
-40C	06-0017-37	• PLATE, Information	UV	1
-40D	06-0017-40	• PLATE, Information	TW	1
-40E	06-0022-45	• PLATE, Information	Y	1
		(ATTACHING PARTS)		
50	MS21318-14	• SCREW, Drive	TW	2
	MS21318-14	• SCREW, Drive, REPLD BY MS21318-13	JLNPUV	2
-50A	MS21318-13	• SCREW, Drive, REPLS MS21318-14	JLNPUV	2
	MS21318-13	• SCREW, Drive	Y	2
		---------- * ----------		
-60	06-123301	• LABEL, FAA-PMA NOTE: If the generator models are received with the FAA-PMA label, only then install the label to the model before dispatch.	UV	1
70	23032-1331	• COVER ASSEMBLY, Fan, REPLD BY 23032-1334	AB	1
-70A	23032-1334	• COVER ASSEMBLY, Fan, REPLS 23032-1331	B	1
	23032-1334	• COVER ASSEMBLY, Fan, REPLS 23032-1331, REPLD BY 23032-3671	A	1
-70B	23032-3671	• COVER ASSEMBLY, Fan, REPLS 23032-1334	A	1
	23032-3671	• COVER ASSEMBLY, Fan	G	1
-70C	23032-1336	• COVER ASSEMBLY, Fan	IJKLM NP	1
	23032-1336	• COVER ASSEMBLY, Fan, REPLD BY 23032-3670	UV	1
-70D	23032-3670	• COVER ASSEMBLY, Fan, REPLS 23032-1336	UV	1
-70E	23032-2890	• COVER ASSEMBLY, Fan	RSTW	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-70F	23081-1090	• INLET, Air	XZ	1
-70G	23032-2891	• COVER ASSEMBLY, Fan	Y	1
		(ATTACHING PARTS)		
80	05-346370	• SCREW, Machine, Binding Head	ABGRS TWXYZ	4
-80A	05-346371	• SCREW, Machine, Binding Head	IJKLM NPUV	4
		---------- * ----------		
-90	DELETED			
100	23032-1380	• BRUSH	ABG	4
-100A	23033-1141	• BRUSH	IJKLM NPUV	4
-100B	30300-1390	• BRUSH	Z	4
	30300-1390	• BRUSH . . . . . SUPSD BY 23081-1855	RSTWX	RF
-100C	23081-1803	• BRUSH	Y	4
-100D	23081-1855	• BRUSH . . . . . .MOD B SUPSDS 30300-1390 (SB 23032-0XX-24-05)	RSTWX	4
		(ATTACHING PARTS)		
110	05-340200	• SCREW, Machine, Binding Head	ABGIJ KLMNP UV	4
-110A	05-340201	• SCREW, Machine, Binding Head	RSTWX YZ	4
		---------- * ----------		
120	23032-1295	• SHAFT, Drive, ... REPLD BY 23032-1297	AB	1
-120A	23032-1297	• SHAFT, Drive, ... REPLS 23032-1295	AB	1
120B	23032-2843	• SHAFT, Drive	G	1
-120C	23032-2842	• SHAFT, Drive	IJ	1
-120D	23032-2844	• SHAFT, Drive	KLUV	1
-120E	23032-1693	• SHAFT, Drive	M	1
-120F	23032-2845	• SHAFT, Drive	NP	1
-120G	23032-1299	• SHAFT, Drive	RZ	1
-120H	23032-2846	• SHAFT, Drive	STWX	1
-120J	23032-2850	• SHAFT, Drive	Y	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		(ATTACHING PARTS)		
130	02-4107-01	• NUT, Self-Locking . . . . . REPLD BY MS21042-4	ABIJKL MNPRS TUVWX Z	1
-130A	MS21042-4	• NUT, Self-Locking, ... REPLS 02-4107-01, Refer to SIL 23703	ABIJKL MNPRS TUVWX Z	1
	MS21042-4	• NUT, Self-Locking	GY	1
140	AN960-416L	• WASHER, Flat	M	1
	AN960-416L	• WASHER, Flat, ... REPLD BY AN960-416	ABIJKL NPUV	1
-140A	AN960-416	• WASHER, Flat, ... REPLS AN960-416L	ABIJKL NPUV	1
	AN960-416	• WASHER, Flat	GRSTW XZ	1
-140B	NAS1149F0463P	• WASHER, Flat, ... ALT AN960-416	Y	1
	AN960-416	• WASHER, Flat, ... ALT NAS1149F0463P	Y	1
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150	MS29561-113	• PACKING, Preformed, ... REPLD BY M83248/1-113	IJKLNP	1
-150A	M83248/1-113	• O-RING . . . . . REPLS MS29561-113	IJKLNP	1
	M83248/1-113	• O-RING	GSTUV WXY	1
160	23032-1900	• HUB, Dampener		1
170	23032-1910	• PLATE, Dampener		1
180	02-5600-05	• RING, Friction, ... **WARNING: CAN CONTAIN ASBESTOS.** SUPSD BY 02-5600-13		RF
-180A	02-5600-13	• RING, Friction, ... SUPSDS 02-5600-05, Refer to SIL 02-5600		1
190	23032-1280	• BACKPLATE, Dampener, ... SUPSD BY 23032-2711	AB	RF
-190A	23032-2711	• BACKPLATE, Dampener, ... SUPSDS 23032-1280	AB	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-190A (Contd)	23032-2711	• BACKPLATE, Dampener	GIJKLM NPRST UVWXY Z	1
200	23032-1301	• FAN ASSEMBLY, ... SUPSD BY 23048-1481	AB	RF
-200A	23048-1481	• FAN, Axial, ... SUPSDS 23032-1301	AB	1
	23048-1481	• FAN, Axial	G	1
-200B	23032-1303	• FAN ASSEMBLY, ... REPLD BY 23048-1483	IJKLNP UV	1
-200C	23048-1483	• FAN, Axial . . . . . REPLS 23032-1303	IJKLMU V	1
	23048-1483	• FAN, Axial . . . . . ALT 23032-1303	NP	1
-200D	23065-1771	• FAN ASSEMBLY . . . . . SUPSD BY 23065-1871	R	RF
-200E	23065-1871	• FAN, Axial, ... SUPSDS 23065-1771	R	1
	23065-1871	• FAN, Axial	STWY	1
-200F	23065-1874	• FAN, Axial	XZ	1
210	23032-1575	• BELL, End, Drive End, ... ALT 23032-1402	AGRTW XZ	1
-210A	23032-1402	• BELL, End, Drive End, ... ALT 23032-1575	AGRTW XZ	1
-210B	23032-1203	• BELL, End, Drive End, ... ALT 23032-1202	BS	1
-210C	23032-1202	• BELL, End, Drive End, ... ALT 23032-1203	BS	1
210D	23032-2210	• BEARING SUPPORT ASSEMBLY, . . . Drive End, REPLD BY 23032-2215	IJKLM NP	1
	23032-2210	• BEARING SUPPORT ASSEMBLY, ... Drive End, REPLD BY 23032-2211	UV	1
-210E	23032-2211	• BEARING SUPPORT ASSEMBLY, ... Drive End, REPLS 23032-2210, REPLD BY 23032-2215	UV	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-210E (Cont.)	23032-2211	• BEARING SUPPORT ASSEMBLY, . . . Drive End, REPLD BY 23032-2215	Y	1
-210F	23032-2215	• BEARING SUPPORT ASSEMBLY, . . . Drive End REPLS 23032-2210 AND 23032-2211	IJKLMN PUVY	1
		(ATTACHING PARTS)		
220	05-341303	• SCREW, Cap, Socket Head	AGRST WXZ	8
-220A	AN503-8-10	• SCREW, Cap, Socket Head,. . . . . REPLD BY 05-341302	IJKLMN PUV	8
-220B	05-341302	• SCREW, Cap, Socket Head,. . . . . REPLS AN503-8-10	IJKLMN PUV	8
	05-341302	• SCREW, Cap, Socket Head	BY	8
230	AN935-8L	• LOCKWASHER, ... REPLD BY MS35338-42	AB	8
	AN935-8L	• LOCKWASHER, ... REPLD BY MS35338-42	IJKLMN PUV	8
-230A	MS35338-42	• LOCKWASHER, ... REPLS AN935-8L	AB	8
	MS35338-42	• LOCKWASHER, ...	GRSTW XYZ	8
	MS35338-42	• LOCKWASHER, ... REPLS AN935-8L	IJKLMN PUV	6
-240	MS35333-38	• WASHER, Tooth Lock, ... ALT 05-700105	IJKLMN PUV	2
-240A	05-700105	• WASHER, Tooth Lock, ... ALT MS35333-38	IJKLMN PUV	2
250	05-370176	• WASHER, Flat	ABGRS TWXYZ	8
	05-370176	• WASHER, Flat	IJKLMN PUV	6
		---------- * ----------		
260	23032-2100	• • BELL, End, Drive End,. . . . . (Part of 23032-2210) REPLD BY 23081-1130	IJKLMN PUV	1
-260A	23032-2101	• • BELL, End, Drive End,. . . . . (Part of 23032-2211) REPLD BY 23081-1130	UVY	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-260B	23032-3651	• • BELL, End, Drive End,. . . . . (Part of 23032-2215) REPLD BY 23081-1130	IJKLMN PUV	1
-260C	23081-1130	• • BELL, End, Drive End,. . . . . REPLS 23032-2100, 23032-2101 and 23032-3651 **NOTE:** This sub-assembly part does not include paint. The Assembly must be purchased to include paint	IJKLMN PUVY	1
270	23032-2220	• • SCREEN	IJKLMN PUVY	1
		(ATTACHING PARTS)		
280	MS21318-14	• • SCREW, Drive.	IJKLMN PUVY	4
290	AN960-4L	• • WASHER.	IJKLMN PUVY	4
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300	MS9013-17	• RING, Retaining, ... REPLD BY MS16624-1066	ABIJKL MUV	1
	MS9013-17	• RING, Retaining	NP	1
-300A	MS16624-1066	• RING, Retaining . . . . . REPLS MS9013-17	ABIJKL MUV	1
	MS16624-1066	• RING, Retaining	GRSTW XYZ	1
310	23032-1143	• DISC, Baffle		2
320	07-111140	• BEARING, Ball . . . . . SUPSD BY 03-6009-19	ABIJK LMNP	RF
-320A	03-6009-19	• BEARING, Ball, ...MOD A SUPSDS 07-111140, SUPSD BY 03-6009-23	ABIJK LMNP	RF
-320B	03-6009-23	• BEARING, Ball, ...MOD B SUPSDS 03-6009-19, See SB 23032-0XX-24-03	ABIJK LMNP	2
	03-6009-23	• BEARING, Ball	GY	2
-320C	03-6009-07	• BEARING, Ball, ... SUPSD BY 03-6009-18	RSTUV WXZ	RF
-320D	03-6009-18	• BEARING, Ball, ...MOD A SUPSDS 03-6009-07, See SB 23032-0XX-24-01	RSTUV WXZ	2
330	23032-1920	• ARMATURE	ABG	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-330A	23032-2111	• ARMATURE	IJKLMN PUV	1
-330B	23032-1922	• ARMATURE	RSTWX YZ	1
340	23032-1230	• RETAINER, Bearing	ABGIJK LMNP UV	1
-340A	23081-1080	• RETAINER, Bearing	RSTWX YZ	1
		(ATTACHING PARTS)		
350	AN500A8-8	• SCREW, ... REPLD BY MS35265-45	ABUV	4
	AN500A8-8	• SCREW. . . . . REPLD BY MS35265-45	IJKLM NP	4
-350A	MS35265-45	• SCREW, Machine, Fillister Head, ... REPLS AN500A8-8	ABUV IJKLM NP	4
	MS35265-45	• SCREW, Machine, Fillister Head, ...	GRSTW XYZ	4
360	AN935-8L	• LOCKWASHER, ... REPLD BY MS35338-42	ABIJKL MNPUV	4
-360A	MS35338-42	• LOCKWASHER, ... REPLS AN935-8L	ABIJKL MNPUV	4
	MS35338-42	• LOCKWASHER, ...	GRSTW XYZ	4
		---------- * ----------		
-370	23032-1423	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY	ABG	1
-370A	23033-302	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY	IJKLM NP	1
	23033-302	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY REPLD BY 23032-340	UV	1
-370B	23081-302	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY REPLD BY 23081-303	RSTWX Z	1
-370C	23032-340	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY REPLS 23033-302	UV	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-370D (Cont.)	23081-303	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY REPLS 23081-302	RSTWX Z	1
-370D	23081-303	• BEARING AND BRUSH SUPPORT, . . . ASSEMBLY REPLD BY 23081-306	Y	1
-370E	23081-306	• BEARING AND BRUSH . . . . . .MOD A SUPPORT ASSEMBLY REPLS 23081-303, REPLD BY 23081-309	Y	1
-370F	23081-309	• BEARING AND BRUSH SUPPORT . . . ASSEMBLY REPLS 23081-306	Y	1
		(ATTACHING PARTS)		
380	05-341310	• SCREW, Cap, Socket Head	ABGRS TWXZ	8
	05-341310	• SCREW, Cap, Socket Head, ... REPLD BY MS16995-30	Y	8
-380A	AN503-8-16	• SCREW, Machine, Fillister Head, ... REPLD BY 05-341306	IJKLMN PUV	8
-380B	MS16995-30	• SCREW, Cap, Socket Head, ...MOD A REPLS 05-341310, ALT 05-341306	Y	8
-380C	05-341306	• SCREW, Cap, Socket Head, ... REPLS AN503-8-16	IJKLM NPUV	8
	05-341306	• SCREW, Cap, Socket Head, ... ALT MS16995-30	Y	8
390	AN935-8L	• LOCKWASHER, ... REPLD BY MS35338-42	AB	8
	AN935-8L	• LOCKWASHER, ... REPLD BY MS35338-42	IJKLM NPUV	6
-390A	MS35338-42	• LOCKWASHER, ... REPLS AN935-8L	AB	8
	MS35338-42	• LOCKWASHER, ...	GRSTW XYZ	8
	MS35338-42	• LOCKWASHER, ... REPLS AN935-8L	IJKLM NPUV	6
-400	MS35333-38	• WASHER, Tooth Lock, ... ALT 05-700105	IJKLM NPUV	2
-400A	05-700105	• WASHER, Tooth Lock, ... ALT MS35333-38	IJKLM NPUV	2

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
410	05-370176	• WASHER, Flat	ABGRS TWYZ	8
	05-370176	• WASHER, Flat	IJKLM NPUV	6
-410A	05-370232	• WASHER, Flat	X	8
		---------- * ----------		
-420	23032-2010	• • HOLDER ASSEMBLY, Brush.	ABG	4
-420A	23033-1100	• • HOLDER ASSEMBLY, Brush.	IJKLM NPUV	4
-420B	23081-1020	• • HOLDER ASSEMBLY, Brush, ... REPLD BY 23081-1021	STWX	4
-420C	23081-1021	• • HOLDER ASSEMBLY, Brush, ... REPLS 23081-1020	STWX	4
	23081-1021	• • HOLDER ASSEMBLY, Brush.	RYZ	4
		(ATTACHING PARTS)		
430	05-346561	• • SCREW, Machine, Binding Head . . .	ABG	8
	05-346561	• • SCREW, Machine, Binding Head, . . . REPLD BY AN3-11A	RSTWX YZ	8
-430A	AN3-11A	• • BOLT . . . . . REPLS 05-346561	RSTWX YZ	8
-430B	05-346560	• • SCREW, Machine, Binding Head . . .	IJKLM NP	8
	05-346560	• • SCREW, Machine, Binding Head . . . REPLD BY 05-346561	UV	8
-430C	05-346561	• • SCREW, Machine, Binding Head . . . REPLS 05-346560	UV	8
440	05-631145	• • SLEEVE, Insulation	ABGIJ KLMNP UV	8
-440A	02-2001-20	• • SLEEVE, Spiral Wound Nomex.	RSTWX YZ	8
450	23032-1660	• • FILTER BOARD ASSEMBLY, ... REPLD BY 23032-1662	ABG	2
-450A	23032-1662	• • FILTER BOARD ASSEMBLY, ... REPLS 23032-1660	ABG	2
-450B	23081-350	• • FILTER BOARD ASSEMBLY.	RSTWX YZ	2
-460	05-652009	• • • LUG, Terminal	RSTWX YZ	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
470	05-374094	• • WASHER, Non-Metallic	ABG	4
-470A	05-374095	• • WASHER, Non-Metallic	IJKLM NPUV	8
-470B	30059-1043	• • WASHER, Insulating	RSTWX YZ	4
480	05-374094	• • WASHER, Non-Metallic		8
490	AN960-10L	• • WASHER, Plain	ABGRS TWXZ	16
	AN960-10L	• • WASHER, Plain, ALT NAS1149F0332P	Y	16
-490A	NAS1149F0332P	• • WASHER, Plain, ALT AN960-10L	Y	16
	AN960-10L	• • WASHER, Plain, NOTE: On these models this is only used under the locknut and not under the screw head.	IJKLMN PUV	8
500	02-4212-15	• • WASHER, Flat, Non-Metallic	RSTWX YZ	8
510	MS20364-1032C	• • NUT, Self-Locking	ABG	8
	MS20364-1032C	• • NUT, Self-Locking, REPLD BY MS21042-3	RSTWX YZ	8
-510A	MS21042-3	• • NUT, Self-Locking	IJKLM NPUV	8
	MS21042-3	• • NUT, Self-Locking, REPLS MS20364-1032C REPLD BY MS21042L3	RSTWX YZ	8
	MS21042L3	• • NUT, Self-Locking, REPLS MS21042-3	RSTWX YZ	8
		---------- * ----------		
520	23032-1700	• • • SPRING	ABG	8
-520A	23033-1122	• • • SPRING	IJKLM NPUV	4
-520B	23081-1180	• • • SPRING	RSTWX YZ	8
530	JH12922	• • • HOLDER, Brush	ABG	4
-530A	23033-1110	• • • HOLDER, Brush, ALT 23033-1111	IJKLM NPUV	4

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-530B	23081-1030	• • • HOLDER, Brush, ... REPLD BY 23081-1710	STWX	4
-530C	23081-1710	• • • HOLDER, Brush, ... REPLS 23081-1030	STWX	4
	23081-1710	• • • HOLDER, Brush.	RYZ	4
540	23032-2163	• • BELL, End, Anti-Drive End	ABG	1
-540A	23032-2162	• • BELL, End, Anti-Drive End	IJKLM NP	1
		• • BELL, End, Anti-Drive End, ... REPLD BY 23032-3660	UV	1
-540B	23032-2167	• • BELL, End, Anti-Drive End	RSTWX Z	1
-540C	23032-3660	• • BELL, End, Anti-Drive End, ... REPLS 23032-2162	UV	1
-540D	23081-3365	• • BELL, End, Anti-Drive End, ... REPLD BY 23081-3320	Y	1
-540E	23081-3320	• • BELL, End, Anti-Drive End, ... REPLS 23081-3365, REPLD BY 23081-3322	Y	1
-540F	23081-3322	• • BELL, End, Anti-Drive End . . . . . REPLS 23081-3320	Y	1
550	23032-1820	• STATOR and HOUSING ASSEMBLY,. . REPLD BY 23032-1823	AB	1
-550A	23032-1823	• STATOR and HOUSING ASSEMBLY,. . REPLS 23032-1820	ABG	1
550B	23032-1822	• STATOR and HOUSING ASSEMBLY,. . REPLD BY 23032-1825	IJKL	1
-550C	23032-1825	• STATOR and HOUSING ASSEMBLY,. . REPLS 23032-1822	IJKL	1
	23032-1825	• STATOR and HOUSING ASSEMBLY . .	MNPY	1
	23032-1825	• STATOR and HOUSING ASSEMBLY,. . REPLD BY 23032-350	UV	1
-550D	23032-350	• STATOR and HOUSING ASSEMBLY,. . REPLS 23032-1825	UV	1
-550E	23032-1828	• STATOR and HOUSING ASSEMBLY . .	RSTWX Z	1
560	MS21042-3	• • NUT, Terminal, Small, Stud		2
570	AN960C10	• • WASHER, Plain.		2
580	MS21042-6	• • NUT, Terminal, Large, Stud		3

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
590	AN960C616	• • WASHER, Plain		3
600	23032-1511	• • BLOCK, Terminal, ... REPLD BY 23032-1518		1
-600A	23032-1518	• • BLOCK, Terminal, ... REPLS 23032-1511		1
		(ATTACHING PARTS)		
610	AN500A10-12	• • SCREW . . . . . REPLD BY MS35265-65		2
-610A	MS35265-65	• • SCREW, Mach, Fillister Hd, ... REPLS AN500A10-12		2
620	AN935-10L	• • LOCKWASHER, ... REPLD BY MS35338-43		2
-620A	MS35338-43	• • LOCKWASHER, ... REPLS AN935-10L		2
630	AN960-10L	• • WASHER, Plain, ... REPLD BY AN960C10L		2
-630A	AN960C10L	• • WASHER, Plain, ... REPLS AN960-10L		2
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640	05-652013	• • • LUG, Terminal, ... ALT 05-652918,05-652015		1
640A	05-652918	• • • LUG, Terminal, ... ALT 05-652013,05-652015		1
640B	05-652015	• • • LUG, Terminal, ... ALT 05-652013, 05-652918		1
645	05-652015	• • LUG, Terminal . . . . . (Used with Stator and housing assy P/N 23032-1825)		2
650	23032-500	• KIT, Quick Attach-Detach	RT	1
	23032-500	• KIT, Quick Attach-Detach . . . . . (Required but not provided)	ABGWXZ	1
-650A	23032-501	• KIT, Quick Attach-Detach	LV	1
-650B	23032-505	• KIT, Quick Attach-Detach	JP	1
-650C	23032-507	• KIT, Quick Attach-Detach . . . . . (Required but not provided)	Y	1
660	23032-1565	• • BELL, End, Drive End Pad, ... (Part of QAD kit 23032-500) ALT 23032-1392	ABGRTWXZ	1

- Not Illustrated

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-660A	23032-1392	• • BELL, End, Drive End Pad, ... (Part of QAD kit 23032-500) ALT 23032-1565	ABGRT WXZ	1
-660B	23032-2201	• • BELL, End, Drive End Pad, ... (Part of QAD kit 23032-501)	LV	1
-660C	23032-2202	• • BELL, End, Drive End Pad, ... (Part of QAD kit 23032-505)	JP	1
-660D	23032-2453	• • BELL, End, Drive End Pad, ... (Part of QAD kit 23032-507)	Y	1
670	23032-1580	• • CLAMP, Rim-Clenching, ... (Part of QAD kit 23032-500) ALT 23032-1586	ABGRT WXZ	1
-670A	23032-1586	• • CLAMP, Rim-Clenching, ... (Part of QAD kit 23032-500) ALT 23032-1580	ABGRT WXZ	1
	23032-1586	• • CLAMP, Rim-Clenching, ... (Part of QAD kit 23032-501, 23032-505 and 23032-507)	JLPVY	1
-680	MS21045-L3	• • • NUT, Hex, Self-Locking		1
-690	23032-2800	• • • T-Bolt		1
Not shown	52-000097	KIT, Modification (Use to modify Mod. 23032-022 to Mod. 23032-027)		RF
Not shown	52-000096	KIT, Modification (Use to modify Mod. 23032-010 to Mod. 23032-018)		RF

- Not Illustrated

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